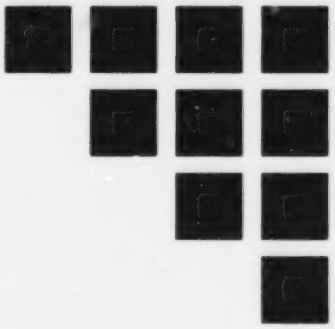
APPLIED RESEARCH BRANCH

Strategic Policy



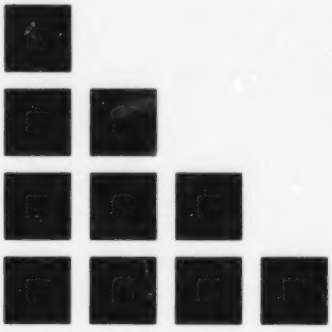
Earnings of University Graduates in Canada by Discipline

What You Study Matters—An Econometric Analysis of Earnings Differences of Bachelor's Level Graduates

R-99-13E.b

by
Ross Finnie
June 1998

Research Paper



Human Resources Development Canada
Développement des ressources humaines Canada

Canada

101-02167/

Applied Research Branch
Strategic Policy
Human Resources Development Canada

Direction générale de la recherche appliquée
Politique stratégique
Développement des ressources humaines Canada

Earnings of University Graduates in Canada by Discipline

What You Study Matters—An Econometric Analysis of Earnings Differences of Bachelor's Level Graduates

R-99-13E.b

by
Ross Finnie
June 1998

The views expressed in Applied Research Branch documents are the authors' and do not necessarily reflect the opinions of Human Resources Development Canada or of the federal government.

Les opinions exprimées dans les documents de la Direction générale de la recherche appliquée sont celles des auteurs et ne reflètent pas nécessairement le point de vue de Développement des ressources humaines Canada ou du gouvernement fédéral.

■

The Research Paper Series includes studies and research conducted under the auspices of the Applied Research Branch of Strategic Policy (SP). Papers published in this series consist of secondary research in the form of background studies and literature reviews that support the research efforts of SP.

La série de documents de recherche comprend des études et des travaux de recherche réalisés sous l'égide de la Direction générale de la recherche appliquée, Politique stratégique (PS). Il s'agit notamment de recherches secondaires sous forme d'études de base et d'analyses documentaires qui appuient les efforts de recherche de PS.

═

Printed/Imprimé 1999
ISBN: 0-662-28094-6
Cat. No./N° de cat.: MP32-29/99-13-2E

General enquiries regarding the documents published by the Applied Research Branch should be addressed to:

Publications Office
Applied Research Branch
Strategic Policy
Human Resources Development Canada
165 Hôtel de Ville Street, Phase II, 7th Floor
Hull, Quebec, Canada
K1A 0J2

Telephone: (819) 994-3304
Facsimile: (819) 953-9077
E-mail: research@spg.org
http://www.hrdc-drhc.gc.ca/arb/

Si vous avez des questions concernant les documents publiés par la Direction générale de la recherche appliquée, veuillez communiquer avec :

Service des publications
Direction générale de la recherche appliquée
Politique stratégique
Développement des ressources humaines Canada
165, rue Hôtel-de-Ville, Phase II, 7e étage
Hull (Québec) Canada
K1A 0J2

Téléphone : (819) 994-3304
Télécopieur : (819) 953-9077
Courrier électronique : research@spg.org
http://www.hrdc-drhc.gc.ca/dgra/

Abstract

This paper reports the results of an empirical analysis of earnings differences by field of study among recent Canadian bachelor's level graduates based on the National Graduates Survey series of databases representing individuals who completed their schooling in 1982, 1986, and 1990. It also develops a simple measure of the (conditional) variability of earnings by field of study, represented as the difference between individuals' predicted earnings values and actual earnings levels. The major findings include that:

- There remain significant gender differences in the distribution of graduates by discipline, with little change in this respect over the period covered by this analysis.
- The differences in earnings by discipline are significant and sometimes large, with the highest earnings fields being Other Health, Engineering and Computer Science, Commerce, and Mathematics/Physics; the low earnings fields being Arts and Humanities, Agricultural/Biological Sciences and Other Social Sciences. Education and Economics are in the middle of the earning distribution.
- Adding control variables to the regression models typically reduces the (net) field effects, but "pure" field effects remain even after these other influences are controlled for.
- The patterns are relatively consistent for male and female graduates, at the two and five year interview points, and across the three cohorts of graduates, but there are some notable departures from these norms (with tests indicating that the effects are in fact significantly different along all these dimensions).
- The conditional variability in earnings is relatively constant across cohorts (21 to 27 percent), thus perhaps indicating that labour market outcomes did not necessarily become more variable or uncertain (in this sense) among bachelor's level university graduates over this period. Engineering and Computer Science and Other Health graduates tend to have the most accurately predicted earnings levels, while the greatest (conditional) variation in earnings is among Fine Arts and Humanities graduates.

Various implications of the findings are discussed.

This report is part of a set of research studies comprised of:

Earnings of University Graduates in Canada by Discipline:

- *Fields of Plenty, Fields of Lean—Cross-Cohort Longitudinal Analysis of Early Labour Market Outcomes*
- *What You Study Matters—An Econometric Analysis of Earnings Differences of Bachelor's Level Graduates*

Résumé

Ce document présente les résultats d'une analyse empirique sur les différences de salaires des récents diplômés universitaires au Canada par domaine d'études, fondée sur les *Enquêtes nationales auprès des diplômés*, représentatives d'individus qui ont terminé avec succès un programme d'études en 1982, 1986 et 1990. Ce document présente également une mesure de variation (conditionnelle) simple des revenus par domaine d'études représentée comme la différence entre les valeurs du revenu des prédites individus et les niveaux de rémunération réels. Voici les principales constatations :

- Il subsiste toutefois des différences significatives entre les sexes dans la répartition des diplômés par discipline, mais très peu de changement au cours de la période couverte par cette analyse.
- Les différences des revenus par discipline sont significatives et quelquefois importantes, les domaines les mieux rémunérés étant autres services de santé, génie et informatique, commerce et mathématique-physique; les domaines les moins rémunérés sont les arts et lettres et sciences humaines, les sciences agronomiques et biologiques et autres sciences sociales; pédagogie et économique se trouvent au centre de la répartition des revenus.
- Le fait d'ajouter des variables de contrôle aux modèles de régression réduit généralement les *(net) field effects*, mais les *« pure » field effects* demeurent même après avoir contrôlé les autres effets.
- Les modèles sont relativement cohérents pour les hommes et les femmes au moment des entrevues effectuées deux et cinq ans après la graduation, et à travers les trois cohortes de diplômés, mais il existe des dérogations notables à ces normes (des tests indiquent que les effets sont en fait sensiblement différents pour toutes ces dimensions).
- La variation conditionnelle de salaire est relativement cohérente d'une cohorte à l'autre (21 à 27 pour 100), ce qui peut être une indication que les conditions sur le marché du travail ne sont pas nécessairement devenues plus variables ou incertaines (dans ce sens) parmi les diplômés universitaires au cours de cette période. Les diplômés en génie et informatique et autres services de santé semblent avoir un taux de rémunération plus prévisible, alors que la plus grande variation (conditionnelle) des revenus semble être parmi les diplômés en beaux-arts et en lettres et sciences humaines.

Diverses implications relatives à ces constatations font l'objet d'un examen.

Ce rapport fait partie d'une série de deux études de recherche comprenant :

Earnings of University Graduates in Canada by Discipline:

- *Fields of Plenty, Fields of Lean—Cross-Cohort Longitudinal Analysis of Early Labour Market Outcomes*
- *What You Study Matters—An Economic Analysis of Earnings Differences of Bachelor's Level Graduates*

Acknowledgements

This research was made possible by financial support received from the Applied Research Branch of Human Resources Development Canada. A Social Sciences and Humanities Research Council grant provided assistance for an earlier phase of the work. Helpful discussions have been held with Julian Betts, Doug Giddings, Philip Jennings, John Myles, Garnett Picot, and Ted Wannell, and comments on an earlier draft were received from Philip Jennings, Wayne Roth, and Manon Rouleau. This work has also benefited from other research using these data undertaken with Marie Lavoie. Excellent research assistance was performed by Marc Frenette, Roger Sceviour, and Michel Villeneuve.

Table of Contents

1. Introduction 1

2. The Econometric Models and the Data 4

2.1 The Econometric Models 4

2.2 The NGS Data and the Construction of the Working Samples 7

3. The Empirical Findings 11

3.1 The Distribution of Graduates by Field of Study 11

3.2 Raw Earnings Patterns 13

3.3 Adjusted Earnings Patterns 17

3.4 The (Unexplained) Variation in Earnings by Discipline 23

4. Conclusion 26

Appendix 31

References 41

1. Introduction

One of the classic topics in modern labour economics is the estimation of the returns to education. A large part of this literature focuses on the returns to the number of years and/or specific level of study (high school versus post-secondary, *etc.*). There is, however, also a steadily accumulating literature, most of it American, on the related topic of earnings differences by field of study (or "major"). In basic human capital terms, the more traditional literature focuses more on the *amount* (or level) of human capital, while the latter is more concerned with the specific *type* of human capital.

In this context, the first and foremost contribution of the present paper is to report the results of an empirical analysis of earnings differences by field of study amongst recent Canadian Bachelor's level graduates ("college" graduates in American terms) based on the quite rich, yet relatively under-utilised, National Graduates Survey series of databases, with the three complete waves of the NGS currently available comprising large, representative databases of those who successfully completed their programmes at Canadian colleges and universities in 1982, 1986, and 1990, with information gathered during interviews conducted two and five years after graduation for each group of graduates (1984/87, 1988/91, 1992/95).[1]

The NGS data have numerous strengths pertaining to this study. First, its longitudinal element (deriving from the two interviews undertaken for each cohort) allows the evolution of earnings differences by field of study to be tracked over the early years in the labour market, with the five-year interviews providing a perspective of longer-run earnings patterns (the average age of graduates is over thirty by this point). Second, the availability of the three full waves of NGS

[1] This paper is one in a series on the school-to-work transition and early years in the labour market of post-secondary graduates based on the NGS data by this author. Finnie [1999d] documents the employment and earnings patterns of graduates at all levels of post-secondary study (College, Bachelor's, Master's, Ph.D.), Finnie [1999b] analyses the changes in the structure of graduates' earnings across cohorts using standard regression-based decomposition techniques, Finnie [1999a] focuses on the dynamic elements of the school-to-work transition of Bachelor's level graduates, and Finnie [1999c] looks at various outcomes by field of study in a descriptive manner. Other work by the author using these same data includes Betts, Ferrall, and Finnie [1998], which uses a hazard model framework to look at the time to first job and Betts, Ferrall, and Finnie [1999], which studies the effects of school quality on Bachelor's graduates' earnings; Burbidge and Finnie [1999] which investigates the inter-provincial mobility of graduates; Lavoie and Finnie [1999], which focus on the early careers of science and engineering graduates, along with a related series of articles (Lavoie and Finnie [1998a, b, c,] which focus on engineering graduates in the context of the accumulation of technology; Finnie and Wannell [1999] and Abbott, Finnie and Wannell [1999], which look at gender differences in outcomes; Finnie and Gameau [1996, 1999] and Finnie and Schwartz [1996] which study graduates in the context of student loans; plus other work nearing completion or otherwise in progress.

data facilitates the comparison of earnings differences by field of study across several different cohorts of graduates, thus permitting us to separate the more enduring patterns from those which have been more transient and to begin to identify trends – all the while covering a period (from the early 1980s into the mid-1990s) thought to have been one of important labour market changes, especially for younger workers.[2] Third, the large sample sizes available and the representative nature of the NGS data mean that there are sufficient numbers of graduates in each discipline to conduct the desired analysis and that the results should generalise to the population of graduates in general. Finally, although the NGS data are lacking in certain background variables one might like to include in an analysis, there are sufficient controls available to estimate the standard sort of earnings models employed in this literature and to observe how the overall earnings differences change as different sets of controls are added to the models.

The secondary element of the paper is the development of a simple measure of the (conditional) variability of earnings by field of study. More precisely, the (absolute) difference between the regression-based predicted (log) earnings value and the actual earnings level is calculated for each individual and the resulting "average error" is compared by field of study. This measure could be thought of as capturing the unpredictable variation in earnings by field of study, which is interesting from a descriptive perspective, represents a factor which individuals would presumably take into account in making career decisions with respect to discipline, and tells us something about the particular labour markets faced by the graduates of different disciplines. We thus add an element to the analysis of earnings differences by discipline which has typically been missing from earlier studies and which could perhaps be built upon in future research.

The findings reported below should be of interest to a variety of readerships. First, scholars in the areas of labour economics, education studies, and related disciplines should find the results of interest for what they tell us about early career labour market outcomes and the relation of these to individuals' schooling backgrounds, especially in light of evidence that the major portion of real lifetime earnings growth occurs during the first few years of young people's post-schooling careers (Murphy and Welch [1990]). Second, policy makers should find the results pertinent to

[2] Beaudry and Green [1997], Beach and Slotsve [1996], Finnie [1997a], Morissette and Bérubé [1996], Morissette, Myles, and Picot [1995], Picot [1997], Riddell [1995], and Zyblock [1997] all report that the earnings of younger workers have been declining in relative and/or absolute terms over this period; while Beaudry and Green, Morissette and Bérubé, Beach and Finnie [1998], Finnie [1997a, b, c], and Finnie and Gray [1998] find that younger workers' movements up the earnings ladder over the early years in the labour market have also slowed.

thinking about differences in the value of post-secondary education (at least as far as earnings are concerned) and which fields should perhaps receive higher or lower priority in terms of future spending – although this paper does not represent any sort of proper benefit-cost analysis, in that the cost side of ledger is left completely unaddressed and there is no attempt to interpret individuals' earnings flows in terms of associated social benefits. Finally, graduates who have already been through the system might be interested in comparing their own experiences to those of others, while current and future students should benefit from being able to plan and make choices – including those concerning field of study – in a more informed context.

The paper is laid out in a straightforward manner: the next section discusses the econometric models and the data, followed by the presentation of the empirical findings, while the concluding section summarises the findings, discusses some of the implications of the findings, and suggests avenues for future work.

2. The Econometric Models and the Data

The first part of this section describes the econometric models used in the analysis, while the second describes the National Graduates Survey data and the selection of the working samples.

2.1 The Econometric Models

The Basic Earnings Specifications and the Field Effects

The primary objective of this paper is to estimate the differences in labour market earnings by field of study for recent post-secondary graduates at two specific points in time after leaving school (corresponding to the interview dates of the NGS data employed in this analysis). The standard approach which has been established in the literature is to estimate earnings models which include indicators of the graduate's discipline while controlling for various other influences. The models used in this analysis conform to standard conventions adapted to the post-graduation period and the information available in the NGS databases, with earnings taken to be a function of series of variables representing the individual's human capital and other factors that affect earnings. The specific variables included in the models are described below.

One slight adaptation of the standard approach is to include dummy variables for each discipline group while imposing restrictions on the parameter estimates which force the field of study coefficients to be expressed relative to the mean, rather than the more usual approach of using an omitted category as the baseline against which other field effects are measured. The latter approach suffers from each of the coefficient estimates (*i.e.*, the field effects) being expressed relative to the baseline (omitted) category, with various pair-wise comparisons required to gauge the effects of any specific discipline relative to the others. Furthermore, the estimated effects shift with the earnings of the baseline group, rendering cross-year and cross-sex comparisons particularly complex (*e.g.*, a decrease (increase) in the relative earnings of the baseline group would cause all other coefficients to rise (fall)). The approach adopted here thus allows for a more straight-forward, meaningful, and robust "relative to the average" interpretation of all the field effects.

The models are estimated separately for men and women for each of the six interview dates corresponding to the two and five year points in time following graduation for which interviews

were carried out for each of the three cohorts of graduates. Such a detailed approach was adopted after conventional tests indicated that it was generally inappropriate to pool across years or by sex. That is, the structure of earnings has been sufficiently different from two to five years following graduation for a given cohort, across cohorts, and by sex to require the estimation of separate models for each period for male and female graduates separately. This also holds for the field effects themselves: pooling was rejected even after allowing all non-field parameters to vary freely across interview dates (and sex), thus indicating in a formal fashion that the field effects vary significantly from two to five years following graduation and across cohorts – indeed, one of the elements upon which this analysis focuses.

The earnings variable available on the NGS databases represents what the graduate would earn on an annual basis were the job held at the time of the interview to last the full year, regardless of the actual job status (*i.e.*, the number of weeks worked). In adjusting for irregular work patterns in this manner, the measure represents the individual's rate of pay as measured on an annual basis rather than the amount necessarily earned. It is a somewhat unconventional measure, but is relatively well-defined and analytically appropriate concept and thus suits the purposes of this study. All earnings values are expressed in constant 1995 dollars, rounded to the nearest thousand, and capped at the $99,000 upper limit which characterises the 1984 data (the lowest bound in the six databases), or $143,035 in constant 1995 dollars.[3]

Standard practice is followed by using the natural log of earnings as the dependent variable, allowing the coefficient estimates to be interpreted in (approximately) percentage terms. Three models are specified. The first model includes no regressors except for the field of study indicators, and thus reveals the "raw" earnings differentials by discipline. The second model includes variables representing labour market experience, previously held degrees, and personal characteristics, thus yielding the earnings differences by field which hold after controlling for these factors. The third model adds dummy variables representing the individual's occupation and industry, but since these variables are fairly strongly correlated with field of study and pick up some of the effects which should properly be assigned to the latter, the discussion is mostly focused on the shorter models and, except for a graphical comparison of results across the three

[3] See Finnie [1999d] for further discussion of the capping exercise.

models, the findings for the models with occupation and industry included are left to the appendix.

The Discipline Groups and the Other Variables Included in the Models

For the most part, the field of study categorisations reflect standard major discipline groups. While it would also be interesting to look at earnings patterns at a more detailed level, the more aggregated approach was adopted to keep the analysis at the broad level which generally characterises the existing literature, while certain finer differences were allowed for where preliminary estimation indicated substantially different earnings patterns (*e.g.*, Economics is separated from Other Social Sciences, but Computer Science graduates are included with Engineering graduates). One specific differentiation worth noting is the splitting of the natural science and engineering groups: these are often treated together (especially the theoretical and applied sciences), but their earnings patterns are really quite different, as will be seen below.

The field categorisations used in this analysis are, therefore:

- *Education* (Elementary/Secondary Teaching, Other Education)
- *Fine Arts and Humanities*
- *Commerce* (Including Business Administration and related)
- *Economics*
- *Other Social Sciences*
- *Agricultural and Biological Sciences*
- *Engineering* (Including Architecture and Computer Science)
- *Other Health* (Nurses and Other Health Professionals)
- *Mathematics and Physical Sciences*
- *Other Fields/No Specialisation*[4]

The other variables included in the models represent standard sorts of controls corresponding to the information available in the NGS databases. These include the following:

- *Holding a previously obtained higher degree:* a dummy variable indicating that the individual held a higher degree (Master's or Doctorate) before entering the Bachelor's programme.

[4] Represents either truly no specialisation or one too general to be fit into the other categories and not worth putting on its own (just 2-4 percent of the samples in each case).

- *Age and age squared:* note also the sample restriction to individuals under age 35 at graduation, as discussed below).
- *Post-graduation work experience:* proxied with the part-time and full-time employment status as of two specific dates between graduation and the first interview in the case of the first interview regressions (the October in the following year and the January after that), and the addition of the first interview employment status in the second interview regressions. (More conventional experience variables reflecting the total time working are not available in the NGS databases.) Tenure with the current employer was excluded on the grounds that it could capture some of the effects which properly belong to the discipline studied.
- *Part-time work*: standard definition (30 hours), to control for individuals' labour supply decisions.[5]
- *Self-employment:* standard dummy variable indicator (as opposed to a paid worker).
- *Marital Status/Presence of Children*: standard indicators which allow for the effects of children to vary by marital status: single (never married) with/without children, married with/without children; widowed/separated/divorced with/without children.
- *Province/Language:* allows for province/region effects (Atlantic Canada, Quebec, Ontario, Manitoba/Saskatchewan, Alberta, British Columbia and the Territories) plus minority language effects (anglophone in Quebec, francophone outside of Quebec, other language)
- *Industry:* 13 standard industrial sectors.
- *Occupation:* 15 standard occupational groups

2.2 The NGS Data and the Construction of the Working Samples

The National Graduates Surveys

Being relatively new and little used, the National Graduates Surveys (and follow-up) databases merit some general description, provided here in the context of this analysis of earnings patterns by discipline, for which they are quite well suited. First, the NGS databases, developed by Statistics Canada in conjunction with Human Resources Development Canada, are representative of the underlying national population of university graduates, and are large, thus facilitating the meaningful analysis of the post-graduation experience at a detailed level – including by field of study.[6, 7]

[5] As noted below, models restricted to full-time workers have also been estimated, but the results are generally similar to those where the broader (part-time included) samples are used.

[6] The NGS databases are based on a stratified sampling scheme (by province, level of education, and field of study), with all results reported below reflecting the appropriate sample weights. The sampling framework of the NGS databases is established through the use of institutions' administration files on graduates, with those records also providing some of the basic educational information on the NGS files, such as programme and discipline of study. All results reported below reflect the appropriate sample weights, and should therefore be representative of the relevant underlying populations of graduates in each year.

Second, data are available for three separate cohorts of graduates – those who successfully completed their programmes in 1982, 1986, and 1990 – thus permitting the comparison of earnings patterns by discipline for various different "generations" of graduates, and over a period of time generally thought to have been characterised by important changes in labour market outcomes, especially for younger workers.[8]

Third, the longitudinal aspect of the NGS databases, deriving from the two interviews carried out for each cohort, two and five years after graduation, allows the evolution of the field effects to be tracked over the early years in the labour market, while the later date provides a longer-term view of these differentials.

Finally, the NGS databases include information on labour market attachment and personal characteristics, thus allowing these influences to be controlled for as the field effects are estimated (as discussed above).

In summary, the three NGS databases used in this analysis uniquely provide for a focused, detailed, and dynamic analysis of the earnings patterns by field of study of Canadian Bachelor's level graduates in the critical years following graduation from the early 1980s into the mid-1990s. The two dynamic elements of the data – two interviews for each of the three cohorts – are especially unique, since previous work in this area on recent graduates (restricted to U.S. Studies) has typically made cross-cohort comparisons based on databases which are less than perfectly comparable (*e.g.*, the various related U.S. databases of graduates) and has at any one time been able to measure earnings differences at only a single point following graduation for each cohort, while the more general studies (*e.g.* Vaillancourt [1995] and Coté and Sweetman [1997] in the Canadian context) have estimated only a single set of field effects across workers of all ages and all levels of education, thus boiling a relatively wide range of effects down to a few overall parameters which are not only broad averages of effects which vary significantly (*i.e.*, the differences vary over the years in the labour market), while also completely missing the

[7] The databases also include college and trade and vocational school graduates, and university graduates at the Master's and Ph.D. levels, but these individuals are not included in the present analysis.

[8] The first survey of the class of 1995 graduates has been carried out, but those data were not ready for analysis at the time this project was started and will obviously lack the second interview data until those are collected in the year 2000. Furthermore, the earnings variable was changed from what was used in the earlier surveys, thus perhaps rendering cross-cohort comparisons problematic.

evolution of these patterns over the life cycle (recall the rejection of the much simpler pooling restrictions by cohort and interview year noted above).

Selection of the Working Samples

The models were estimated for all Bachelor's level individuals who held jobs as of the interview dates who met the following sample restrictions.[9] First, individuals who were thirty-five years or older or who had five or more years of full-time work experience at the time of graduation were excluded from the analysis. While such "mature" students are interesting in their own right, it was decided to estimate "pure" field effects untainted by previous experiences by focusing on "fresh" graduates and to leave the others for a separate analysis.

Secondly, individuals who obtained an additional degree by a particular interview date were deleted from the analysis at that point. This was done on the grounds that such graduates no longer belonged to the original education group (*e.g.*, a Bachelor's graduate might have become a Master's graduate and perhaps changed disciplines) and/or had in any event been mixing school and work in a way likely to affect the labour market outcomes upon which this analysis is focused. Including on-going students would also have thrown off the precise post-graduation time frame corresponding to the two interview dates (*i.e.*, two and five years after graduation) which holds for the non-continuing group. Furthermore, and of particular relevance to this paper, it is impossible to identify the specific field of study – obviously a critical piece of information – in which any new degree was obtained as of the 1984 survey for the 1982 graduates.

Third, part-time workers who cited school as the reason for their only partial involvement in the labour market were also deleted on the grounds that such individuals were – by definition – still principally students and had therefore not yet entered the school-to-work transition phase of their

[9] Law graduates, as well as medical doctors, dentists, optometrists, and other related medical professionals were deleted from this analysis, as these represent professional degrees which generally require individual to have already obtained a first diploma and are characterised by earnings levels a great deal higher than those of all other graduates (especially in the case of the medical fields). That is, they are a fundamentally different set of graduates, and on a practical level, including them would distort the analysis, including rendering the graphical presentations of the results offered below problematic due to the required rescaling of the graphs. Results with these groups included are available from the author upon request. Such graduates are, furthermore, included in the more descriptive analysis of post-graduation outcomes along a broader range of measures (including earnings) represented in Finnie [1999c].

careers in earnest. Other part-time workers were, on the other hand, generally included in the analysis, lending it a broad labour market base.[10]

Finally, observations were deleted for the relatively small number of individuals who were neither regular wage nor self-employed workers (*i.e.*, volunteers, family workers), were missing the information required for the models, or who had unreasonably low earnings.[11]

[10] As noted above, results for full-time workers only are available from the author, but the general patterns are similar to those reported below (part-time workers included).

[11] Concerning the latter condition, full-time workers with less than $5,000 in annual earnings (the equivalent of a wage of about $3.20 per hour for 30 hours of work per week over 52 weeks) were deleted. These deletions together affected only 1-2 percent of the sample in each year.

3. The Empirical Findings

The discussion of the empirical findings focuses on the following main themes:

- the identification of generally low, medium and high earnings fields of study;
- the evolution of the earnings patterns from two to five years following graduation;
- the cross-cohort patterns: stability, cyclical effects, secular trends;
- male versus female comparisons;
- the role of intermediary influences (labour market experience, personal characteristics, *etc.*) on the overall earnings patterns;
- differences in the variance in the variability of earnings around the regression-based predicted values.

3.1 The Distribution of Graduates by Field of Study

Table 1 shows the distribution of graduates by discipline group. Interestingly, the distributions were generally quite stable across cohorts. For men, there was an increase in the percentage of pure and applied science and engineering/computer graduates from the first cohort to the second (from 36 percent to 40 percent), but this share then dropped back again in the third cohort (35 percent, although with some juggling amongst the specific disciplines, most notably a slight decline in Engineering and Computer Science). These shifts in the share of technical/scientific graduates were mirrored in the offsetting trends evidenced by the Other Social Science category (15, 12, and 15 percent for the three cohorts). None of the other fields varied more than one percentage point over time. As a result, the distribution of male graduates in the third cohort was generally quite similar to that of the first.

For women, the distributions were – not surprisingly – quite different. Female graduates have been much more likely than men to graduate with degrees in Education, Fine Arts and Humanities, and Other Health (*i.e.*, a group representing graduates in the health area apart from the doctors and related who are excluded from this analysis, as explained in a note above), and to a lesser degree in Commerce and the Other Social Sciences; they have been greatly under-represented in Economics, Engineering and Computer Science, and Mathematics and the Physical Sciences; while the shares of male and female graduates have been quite similar in the Agricultural and Biological Sciences.

Table 1: The Distribution of Graduates by Field of Study

	1982 Cohort (percent)	1986 Cohort (percent)	1990 Cohort (percent)
Males			
Other fields	3	5	4
Education	9	9	10
Fine Arts & Humanities	12	12	13
Commerce	16	16	16
Economics	7	6	7
Other Social Sciences	15	12	15
Agric. & Bio. Sc.	6	6	7
Engineering & Comp. Sc.	23	24	20
Other Health	1	2	2
Math. & Other Phys. Sc.	6	8	6
	100	100	100
Females			
Other Fields	2	4	3
Education	24	19	20
Fine Arts & Humanities	20	18	18
Commerce	10	12	12
Economics	2	3	2
Other Social Sciences	20	22	23
Agric. & Bio. Sc.	7	6	8
Engineering & Comp. Sc.	3	5	3
Other Health	9	8	7
Math. & Other Phys. Sc.	3	3	3
	100	100	100

Note: In this and all following tables, the samples exclude those who were older than 35 or who had more than five years of full-time experience by the date of graduation; those who were not regular paid or self-employed workers; those with unreasonably low earnings; and those missing any of the variables included in the analysis.

As for cross-cohort patterns, the share of female graduates in the scientific/technical disciplines was more stable than the case of men, but at their much lower rates (22, 22, and 21 percent), with Engineering and Computer Science remaining the most glaring discrepancy in this regard (23, 24, and 20 percent for men, versus 3, 5, and 3 percent for women). More significant, perhaps, are the declines in the percentage of female graduates with degrees in Education and Fine Arts and Humanities, and the offsetting increases in Commerce and Other Social Sciences. Thus, while there was no general shift of female graduates towards engineering and the sciences (as many would like to see, for various reasons), there was in fact something of a shift away from the fields which have been most female-dominated in the past towards the slightly "harder" social sciences and business.[12]

[12] The role of field of study in the overall gender earnings gap amongst Bachelor's level graduates, as well as other outcomes by gender, are pursued further in Finnie and Wannell [1999]. Finnie [1999c] covers other outcomes by field of study with the entire analysis broken down by gender.

In summary, then, there was little change in the distribution of male graduates across cohorts, but slight shifts amongst female graduates from their traditional domains towards the social sciences and commerce – presumably reflecting a growing commitment to the labour market, steadier job attachment, and a generally stronger orientation towards their careers in general – consistent with what has been found in any other number of studies.

The relative stability of the male graduates is, on the other hand, perhaps somewhat more surprising, and leads to a number of related questions which largely apply to women as well. Was this stability primarily due to demand side or supply side factors with respect to the education system – that is, do these patterns reflect students' preferences or simply the spots available at universities? In particular, is the "production" of graduates in different fields as flexible and responsive as it should be as employment opportunities (and employers' needs) shift over time? Should the general lack of any secular shifts in the distribution of graduates by field of study be cause for worry as the economy moves in directions which would – or at least should – seem to favour certain types of graduates over others?[13] We now turn to look at the associated earnings patterns, which should put these distributions in a much more interesting light.

3.2 Raw Earnings Patterns

Table 2 reports mean earnings (and associated standard deviations) by field of study as of each of the two interview dates, two and five years following graduation (see also the percentage change in mean earnings over time) for the three cohorts of male and female graduates. Table 3 reports the results of regression models which include only an intercept and the field variables – thus putting the same patterns in a more formal econometric framework. Figure 1 plots the field coefficients for this simple model, with the coefficients representing the earnings level of each field relative to the average level across all fields (*i.e.*, the coefficients sum to unity), as explained above.

There are some clear and consistent patterns. Looking first at men, the highest earnings fields are (in order) Other Health (recall that "Other" indicates the absence of doctors, dentists, and other such professionals), Engineering and Computer Science, Commerce, and Mathematics/Physics. The low earnings fields are (from the bottom up) Arts and Humanities, Agricultural/Biological

[13] See Lavoie and Finnie [1999] for the specific case of science and technology graduates.

Sciences, and the (Other) Social Sciences. Education and Economics have more mixed records, but generally lie in the middle of the earning distribution.

Table 2: Mean Earnings (1995 Constant Dollars)

	1982 Cohort			1986 Cohort			1990 Cohort		
	1984 $	1987 $	Change Percent	1988 $	1991 $	Change Percent	1992 $	1995 $	1995 Percent
All	**31,100**	**39,100**	**26**	**31,200**	**38,400**	**23**	**31,600**	**37,700**	**19**
Males									
All	**34,000**	**43,800**	**29**	**33,700**	**42,100**	**25**	**32,800**	**41,100**	**25**
Other Fields	30,400	42,600	40	35,100	45,600	30	30,500	41,700	37
Education	31,100	36,600	18	33,400	38,100	14	31,800	36,800	16
Fine Arts & Humanities	25,900	38,600	49	28,300	35,100	24	23,400	32,400	38
Commerce	33,900	44,800	32	34,900	44,400	27	32,700	42,800	31
Economics	32,100	45,300	41	32,800	39,600	21	32,900	44,200	34
Other Social Sciences	30,400	41,300	36	29,800	36,200	21	28,100	36,800	31
Agricultural & Bio. Sc.	29,400	41,400	41	27,500	39,800	45	26,800	34,800	30
Engineering & Comp. Sc.	38,900	47,000	21	36,200	44,800	24	37,500	46,000	23
Other Health	45,100	62,600	39	47,400	56,700	20	45,300	51,300	13
Math. & Other Phys. Sc.	35,000	46,100	32	33,900	44,700	32	33,200	44,500	34
Females									
All	**28,300**	**34,300**	**21**	**28,800**	**34,700**	**20**	**30,500**	**34,800**	**14**
Other Fields	26,200	-	-	29,800	35,800	20	25,100	36,400	45
Education	27,600	31,900	16	28,700	32,700	14	30,900	33,700	9
Fine Arts & Humanities	23,900	31,000	30	24,200	29,400	21	26,400	31,400	19
Commerce	29,400	37,600	28	30,600	39,100	28	31,300	-	-
Economics	29,100	-	-	32,800	33,700	3	29,700	31,500	6
Other Social Sciences	24,900	31,900	28	26,300	33,200	26	26,600	31,700	19
Agricultural & Bio. Sc.	26,500	33,000	25	25,000	32,200	29	26,300	32,900	25
Engineering & Comp.Sc.	36,700	43,600	19	33,600	41,500	24	36,800	42,400	15
Other Health	35,700	38,800	9	35,000	38,000	9	37,400	40,000	7
Math. & Other Phys. Sc.	33,500	42,800	28	32,000	39,700	24	30,100	39,200	30

The consistency of these patterns is interesting – although it should at the same time be recognised that the estimated effects do in fact vary to a significant degree across surveys. For example, the coefficient for Engineering and Computer Science graduates ranges from a low of .09 (1988) to a high of .21 (1984 and 1992). Thus, the general categorisations into low, medium, and high are broadly consistent over the early years in the labour market and across cohorts, but there is substantial interview-to-interview variation within these broad tendencies, as will be discussed further in the context of the other models presented below.

Figure 1: Model 1 Coefficient Estimates

Table 3: Model 1 - Field Variables Only

	1982 Cohort				1986 Cohort				1990 Cohort			
	1984		1987		1988		1991		1992		1995	
	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.
Males												
Other Fields	-0.12 **	0.05	-0.06	0.07	-0.01	0.04	0.06	0.04	-0.04	0.05	-0.03	0.04
Education	-0.03	0.02	-0.09 **	0.03	0.02	0.02	-0.06 **	0.02	0.05 *	0.03	-0.04	0.02
Arts & Hum.	-0.26 **	0.03	-0.22 **	0.03	-0.13 **	0.03	-0.21 **	0.02	-0.35 **	0.03	-0.22 **	0.02
Commerce	0.05 **	0.02	0.08 **	0.02	0.09 **	0.02	0.07 **	0.02	0.04	0.02	0.05 *	0.02
Economics	0.00	0.03	0.09 *	0.04	-0.07 *	0.03	-0.02	0.03	0.04	0.04	0.05	0.03
Other Soc. Sc.	-0.09 **	0.02	-0.06 *	0.03	-0.05	0.03	-0.08 **	0.03	-0.13 **	0.02	-0.12 **	0.02
Agr. & Bio. Sc.	-0.12 **	0.03	-0.11 **	0.04	-0.18 **	0.03	-0.11 **	0.04	-0.20 **	0.04	-0.15 **	0.04
Eng. & Comp. Sc.	0.21 **	0.02	0.14 **	0.02	0.09 **	0.02	0.11 **	0.02	0.21 **	0.02	0.15 **	0.02
Other Health	0.30 **	0.06	0.18 **	0.07	0.23 **	0.05	0.18 **	0.05	0.36 **	0.06	0.25 **	0.05
Math./Phy. Sc.	0.06 *	0.03	0.06	0.03	0.01	0.03	0.07 *	0.03	0.02	0.04	0.04	0.04
R^2	0.13		0.09		0.06		0.09		0.14		0.09	
Observations	2370		1904		2143		2005		2235		2193	
Females												
Other Fields	-0.14 *	0.06	-0.08	0.07	0.03	0.04	0.03	0.05	-0.13 **	0.05	-0.02	0.04
Education	-0.07 **	0.02	-0.10 **	0.02	-0.01	0.02	-0.05 *	0.02	0.04	0.02	-0.05 *	0.02
Arts & Hum.	-0.24 **	0.02	-0.20 **	0.03	-0.23 **	0.02	-0.16 **	0.02	-0.17 **	0.03	-0.15 **	0.02
Commerce	0.05	0.03	0.07 *	0.03	0.06 **	0.02	0.12 **	0.02	0.08 **	0.03	0.04	0.02
Economics	0.00	0.06	0.00	0.06	0.06	0.04	-0.06	0.05	-0.05	0.06	-0.03	0.06
Other Soc. Sc.	-0.17 **	0.02	-0.05 *	0.03	-0.11 **	0.02	-0.04	0.02	-0.10 **	0.02	-0.10 **	0.02
Agr. & Bio. Sc.	-0.08 *	0.04	-0.10 *	0.04	-0.18 **	0.01	-0.13 **	0.05	-0.11 **	0.04	-0.09 *	0.03
Eng. & Comp. Sc.	0.26 **	0.04	0.22 **	0.05	0.13 **	0.03	0.20 **	0.04	0.21 **	0.05	0.19 **	0.04
Other Health	0.24 **	0.03	0.07 *	0.03	0.18 **	0.02	0.09 **	0.03	0.26 **	0.03	0.13 **	0.03
Math./Phy. Sc.	0.15 **	0.05	0.18 **	0.06	0.07	0.05	0.07	0.06	-0.03	0.05	0.08	0.05
R^2	0.12		0.06		0.10		0.05		0.07		0.04	
Observations	2253		1884		2432		2182		2567		2545	

* One asterisk indicates significance at the .05 confidence level.
** Two asterisks indicate significance at the .01 level.

The patterns for female graduates are relatively similar to those of male graduates at the broadest level, but show some moderate differences in the details. Thus, while the high earnings fields are the same four as was found for men, the relative standing of these is somewhat different, with Engineering and Computer Science graduates generally performing even more strongly than was true for men, Mathematics/Physics graduates also typically doing a little better, and Other Health graduates not doing as well as in the male case. (In this context, recall, from Table 1, the very different distributions across these fields between men and women.)

These are especially interesting findings in the context of the literature which looks at gender earnings patterns according to the percentage of women in each field (typically modelled in terms of occupation). In short, these findings indicate that cross-field earnings patterns are relatively similar for men and women – rather than varying by the extent of "femaleness" of an occupation.

3.3 Adjusted Earnings Patterns

The Standard Models

Table 4 reports the field coefficients generated by the regression models which include the control variables representing labour market experience, personal characteristics, and so on, described above. The field effects shown here are, therefore, net of any influences which operate through those other variables (*e.g.*, certain fields lead to greater full-time employment opportunities, but these effects are controlled for in this model) – as is the usual practice in this literature. Figure 2 graphs the field coefficients. (The full model results are contained in Appendix Table A1.)

The first principal finding is that the general ordering of the field effects is the same as for unadjusted earnings: once again, the high earnings fields are Other Health, Engineering and Computer Science, Mathematics/Physics, and Commerce; the low earnings fields are Arts and Humanities, Other Social Sciences, and the Agricultural and Biological Sciences, while Education and Economics are generally in the middle rank. The effects are smaller than those found in the simple field-only models – but this is to be expected in the presence of the added control variables.

Second, the magnitudes of the cross-discipline differences in earnings are very large, typically varying from 30 to 40 log points between the lowest and highest fields, and soaring as high as 59 points for male Fine Arts and Humanities versus Other Health graduates in 1992 (coefficients of -.30 and .29 respectively). There are, in short, large differences in earnings by field of study, even after controlling for certain basic labour market and personal attributes.

Third, two-year versus five-year patterns – which exploit the longitudinal nature of the NGS data – are interesting; they allow us at least to start plotting the evolution of field effects over individuals' careers and pointing to the longer-term earnings profiles. Graduates with degrees in Education (both males and females) generally saw their relative earnings levels decline from two to five years following graduation—from close to average to decidedly below average. Other Health graduates also saw declines, their relative earnings falling from amongst the very highest at the first interview points to more moderately advantageous levels three years later. These results for these two groups presumably reflect not only "pure" discipline effects, but also the

effects of being in highly unionised public and semi- public sectors. The initially higher but then subsequently flatter earnings profiles are, therefore, not surprising.

Table 4: Model 2 – Adding Basic Control Variables

	1982 Cohort				1986 Cohort				1990 Cohort			
	1984		1987		1988		1991		1992		1995	
	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.
Males												
Other Fields	-0.08	0.04	-0.05	0.06	0.00	0.03	0.05	0.03	-0.02	0.04	-0.04	0.04
Education	0.01	0.02	-0.08 **	0.02	0.03	0.02	-0.05 *	0.02	0.04	0.02	-0.01	0.02
Arts & Hum.	-0.20 **	0.02	-0.15 **	0.03	-0.12 **	0.02	-0.14 **	0.02	-0.30 **	0.02	-0.16 **	0.02
Commerce	0.01	0.02	0.06 **	0.02	0.07 **	0.02	0.06 **	0.02	0.03	0.02	0.05 **	0.02
Economics	0.00	0.03	0.05	0.03	-0.08 **	0.03	-0.06 *	0.03	0.02	0.03	0.03	0.03
Other Soc. Sc.	-0.07 **	0.02	-0.04	0.02	-0.05	0.02	-0.08 **	0.02	-0.11 **	0.02	-0.13 **	0.02
Agr. & Bio. Sc.	-0.09 **	0.03	-0.08 *	0.03	-0.15 **	0.03	-0.10 **	0.03	-0.14 **	0.03	-0.14 **	0.03
Eng. & Comp. Sc.	0.15 **	0.02	0.10 **	0.02	0.08 **	0.02	0.09 **	0.02	0.17 **	0.02	0.14 **	0.02
Other Health	0.20 **	0.05	0.13 *	0.06	0.20 **	0.05	0.17 **	0.05	0.29 **	0.05	0.21 **	0.05
Math./Phy. Sc.	0.07 *	0.03	0.07 *	0.03	0.03	0.03	0.06 *	0.03	0.03	0.03	0.05	0.03
R^2	0.35		0.29		0.24		0.29		0.36		0.30	
Observations	2370		1904		2143		2005		2235		2193	
Females												
Other Fields	-0.05	0.05	-0.03	0.06	0.02	0.04	0.06	0.05	-0.09 *	0.04	0.01	0.04
Education	-0.01	0.02	-0.05 *	0.02	0.02	0.02	-0.01	0.02	0.04 *	0.02	-0.03	0.02
Arts & Hum.	-0.19 **	0.02	-0.17 **	0.02	-0.19 **	0.02	-0.14 **	0.02	-0.13 **	0.02	-0.09 **	0.02
Commerce	0.00	0.02	0.04	0.03	0.03	0.02	0.09 **	0.02	0.04	0.02	0.01	0.02
Economics	-0.02	0.05	-0.02	0.05	0.06	0.04	-0.12 **	0.04	-0.06	0.05	-0.10 *	0.05
Other Soc. Sc.	-0.16 **	0.02	-0.06 **	0.02	-0.12 **	0.02	-0.04 *	0.02	-0.07 **	0.02	-0.07 **	0.02
Agr. & Bio. Sc.	-0.03	0.03	-0.08 *	0.04	-0.15 **	0.03	-0.10 **	0.04	-0.13 **	0.03	-0.07 *	0.03
Eng. & Comp. Sc.	0.18 **	0.04	0.17 **	0.04	0.09 **	0.03	0.15 **	0.03	0.15 **	0.04	0.13 **	0.04
Other Health	0.17 **	0.02	0.08 **	0.03	0.17 **	0.02	0.13 **	0.02	0.24 **	0.03	0.16 **	0.02
Math./Phy. Sc.	0.12 **	0.04	0.12 **	0.05	0.06	0.04	0.05	0.05	-0.01	0.05	0.06	0.04
R^2	0.38		0.35		0.31		0.38		0.33		0.36	
Observations	2253		1884		2432		2182		2567		2545	

Note: The models include controls for pre-programme educational level, age, post-graduation experience, self-employment status, marriage/children, region, and language. See Table A1 for the detailed results for these variables.

* One asterisk indicates significance at the .05 confidence level.

** Two asterisks indicates significance at the .01 level.

Conversely, Fine Arts and Humanities graduates generally experienced relative gains over time, and although their earnings levels generally remained amongst the lowest at the five year points, they were typically not so far behind as they were just two years after graduation (males in the middle cohort are an exception in this regard). This tendency would seem to point to a more "dynamic" labour market for what are typically more "generalist" graduates, with individuals with Bachelor's degrees in these areas in many cases finding interesting job opportunities, gaining promotions, finding their own niches, and generally moving ahead in the workplace in the years following graduation. The other disciplines generally showed no clear, consistent patterns from two to five years following graduation.

These patterns from two to five years following graduation are interesting not only of themselves, but also have implications for other studies which pool graduates of all ages and across years of work experience. It was noted above that pooling across even just the two and five year points represented here is rejected; here we see the specific changes which occur over that interval and which are of course ignored in the more aggregated type studies. It would be interesting to explore this aspect further and see what the longer-term profiles look like (*i.e.*, beyond five years), but this is not possible with the NGS data as currently structured.

The other dynamic nature of the analysis is the cross-cohort patterns: which disciplines have been on an upward earnings trend and which have been falling off – an issue which is perhaps especially pertinent in the context of a general belief in the importance and value of degrees in science and technology disciplines in the new "knowledge based economy". The clearest pattern here – most easily seen by looking at the adjacent graphs representing the relative earnings levels for the three cohorts for each of the interview dates in Figure 2 – is that graduates in Other Health disciplines enjoyed higher relative earnings in the latest cohort than in the first (captured at approximately similar points in the business cycle and thus roughly controlling for general macro conditions). The other technical and scientific disciplines showed no such improvements, however, with the cross-cohort movements in many cases being in the opposite direction. More specifically, both male and female graduates in the Agricultural and Biological Sciences and in Mathematics and the Physical Sciences had lower relative earnings in the third cohort than in the first, except for female Agricultural and Biological graduates at the five year point, whose earnings were steady. Male Engineering and Computer Science graduates did a little better in the latest cohort (after a dip in the second), but this was another area of decline for female graduates. In summary, then, we can at least say that there have been no general gains by the more technically and scientifically oriented graduates – contrary to what many might have expected.[14]

Other fields which gained over time were Education (males and females both) and Fine Arts and Humanities in the case of females, but not males, while other general declines are observed for male Other Social Science graduates. For the other disciplines, the cross-discipline patterns showed no clear trends across the three cohorts.

[14] Lavoie and Finnie [1999] investigate the outcomes of science and technology graduates across a wider range of outcomes using non-econometric techniques and discuss the implications of those findings, especially with respect to science and technology policy.

Adding Occupation and Industry to the Models

The field coefficients generated by the models with occupation and industry included are presented in Appendix Table A2 and shown graphically in Figure A1, while the detailed model results are given in Table A3. The reader is reminded that these controls are fairly highly correlated with, and capture some of the effects of, discipline, and thus generate a generally less interesting set of findings on their own. They are, however, interesting for the light they case on how the discipline effects play out in the labour market.

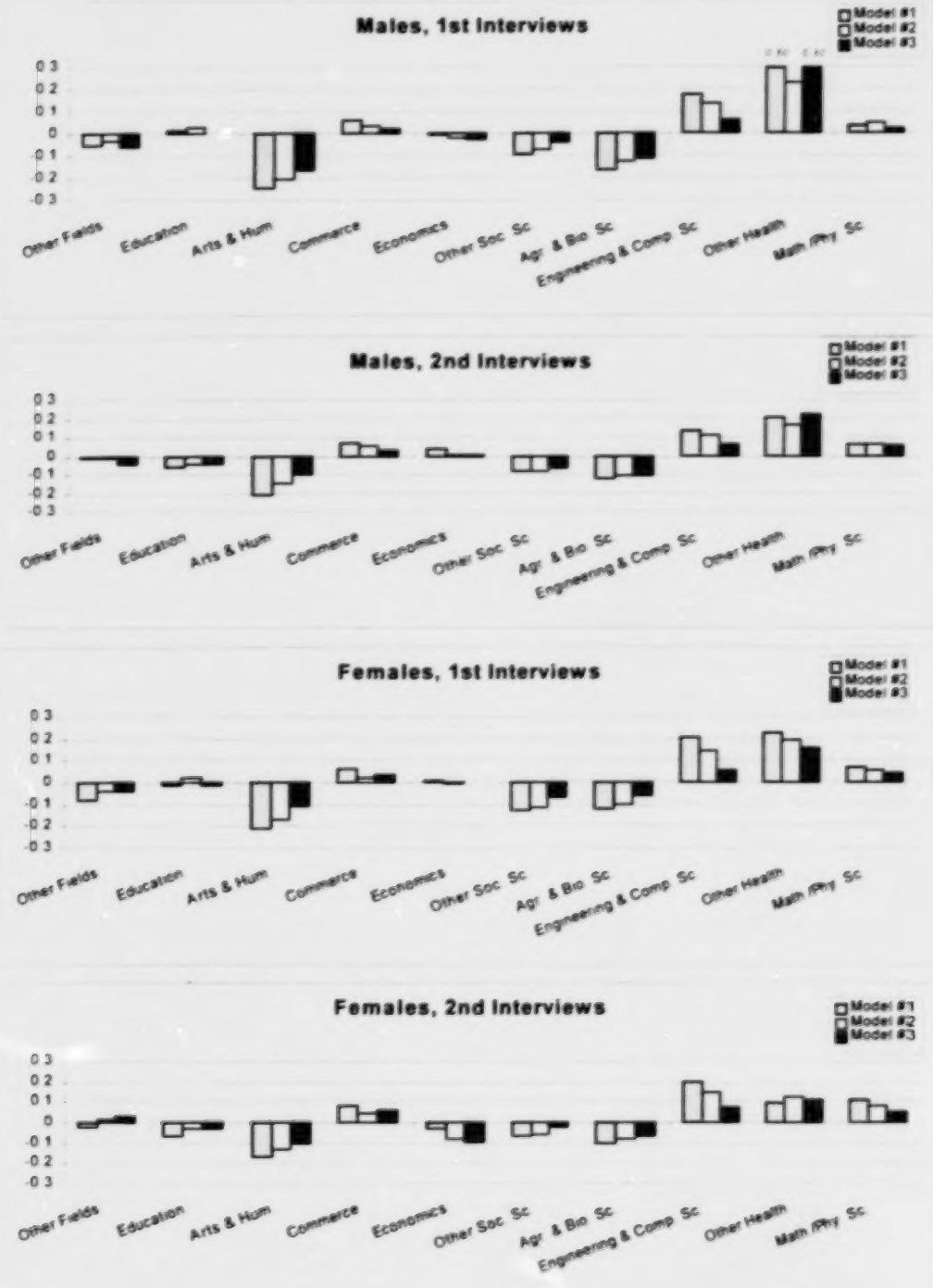
Figure 3 thus plots the coefficients estimated for each of the three models averaged over all three cohorts, thereby showing the effects on the discipline coefficients of adding the two groups of control variables to the specification – as can be verified by looking at the three models for each of the cohorts individually, as shown in Figure A2.[15]

Adding the control variables is seen to generally – but not uniformly – reduce the (net) field effects in the case of both men and women. That is, the high earnings disciplines are not quite as high when the controls are added, the low earnings fields are not as low, and so on. The only really notable exception is the Other Health category in the case of men, where adding occupation and industry to the models actually increases its net advantage, suggesting that such graduates tend to find employment in what are generally (relatively) lower paying occupations and industries (for men). Economics is also of some interest in this respect, as in three of the four cases (excepting only female graduates two years after graduation) the coefficients become moderately less positive or more negative when the extra controls are added, indicating that while economics graduates have approximately average earnings overall, this is due to their having moderately "high earning" labour market and personal attributes, as their earnings are actually below average once such factors are taken into account.

[15] That is, the coefficients shown in Figure 3 represent the simple arithmetic means of the estimated coefficients of the simple fields-only earnings models across the three cohorts, the mean of the models with the basic set of controls included, and the means of the coefficients generated by the models which include occupation and industry.

Figure 2: Model 2 Coefficient Estimates

Figure 3: Mean Coefficients (All Three Cohorts) by Model



3.4 The (Unexplained) Variation in Earnings by Discipline

Table 5 and Figure 4 show the mean absolute difference between predicted and actual earnings by field of study for the Model 2 specifications (the results based on the models including industry and occupation are shown in Appendix Table A4 and Figure A3), thus representing in this log earnings model context the (approximate) average absolute error in percentage terms. To the degree the regression models reflect individuals' own estimates of their future earnings, this measure will also represent the extent of uncertainty of future earnings for a typical graduate in a given discipline.

The differences are interesting. Whereas we would expect some fields, as defined here, to have smaller errors simply because they represent more detailed categorisations and thus smaller and presumably more homogeneous (at least in terms of human capital) groups (*e.g.*, Economics, Agricultural and Biological Sciences), other comparisons can be made across categories representing more broadly defined groups, while it is also interesting to note where the small-versus-large comparisons do not appear to follow a simple aggregation rule.

For all disciplines, actual average earnings deviate from the regression-predicted levels by 21 to 26 percent for men, and from 23 to 27 percent for women. Interestingly, there is no clear trend in the extent of these errors from two to five years following graduation, nor in cross-cohort patterns, except that second cohort errors are slightly smaller than those of the first and last cohorts. There is much talk of uncertain labour markets and more polarised outcomes, but the numbers seem not to support this hypothesis for these groups of Bachelor's level graduates.[16]

By discipline, the most notable outcome is probably the relatively low percentage errors which characterise Engineering and Computer Science graduates, especially in the case of men, presumably representing relatively homogenous groups of workers who face similarly well-defined job opportunities. Other Health disciplines, especially amongst women, also have relatively well-predicted earnings values, as do male Education graduates, again reflecting the same sort of homogeneity as the Engineering and Computing group, as well as the influences of

[16] How "variability", "uncertainty", and "polarisation" are defined is, of course, crucial to such issues. Here we are looking at the variance in earnings around the predicted values which condition on a set of basic labour market and individual attributes. One alternative approach would be to look at unconditional distributions, while another would be to add still more controls. Nevertheless, it is interesting that the conditional distributions reported here are so consistent across cohorts.

typically leading to jobs in highly unionised sectors characterised by standardised wage scales. At the other extreme, Fine Arts and Humanities graduates tend to have the greatest variation in earnings around the regression-based predicted values – hardly a surprising finding in light of the different types of graduates and commensurate variation in earnings opportunities (and perhaps preferences) characterising this broad area. Of perhaps greater surprise is that the single field of Economics is characterised by prediction errors in the middle rank – rather than the smaller errors which we might have expected from such a relatively uniform group of graduates.

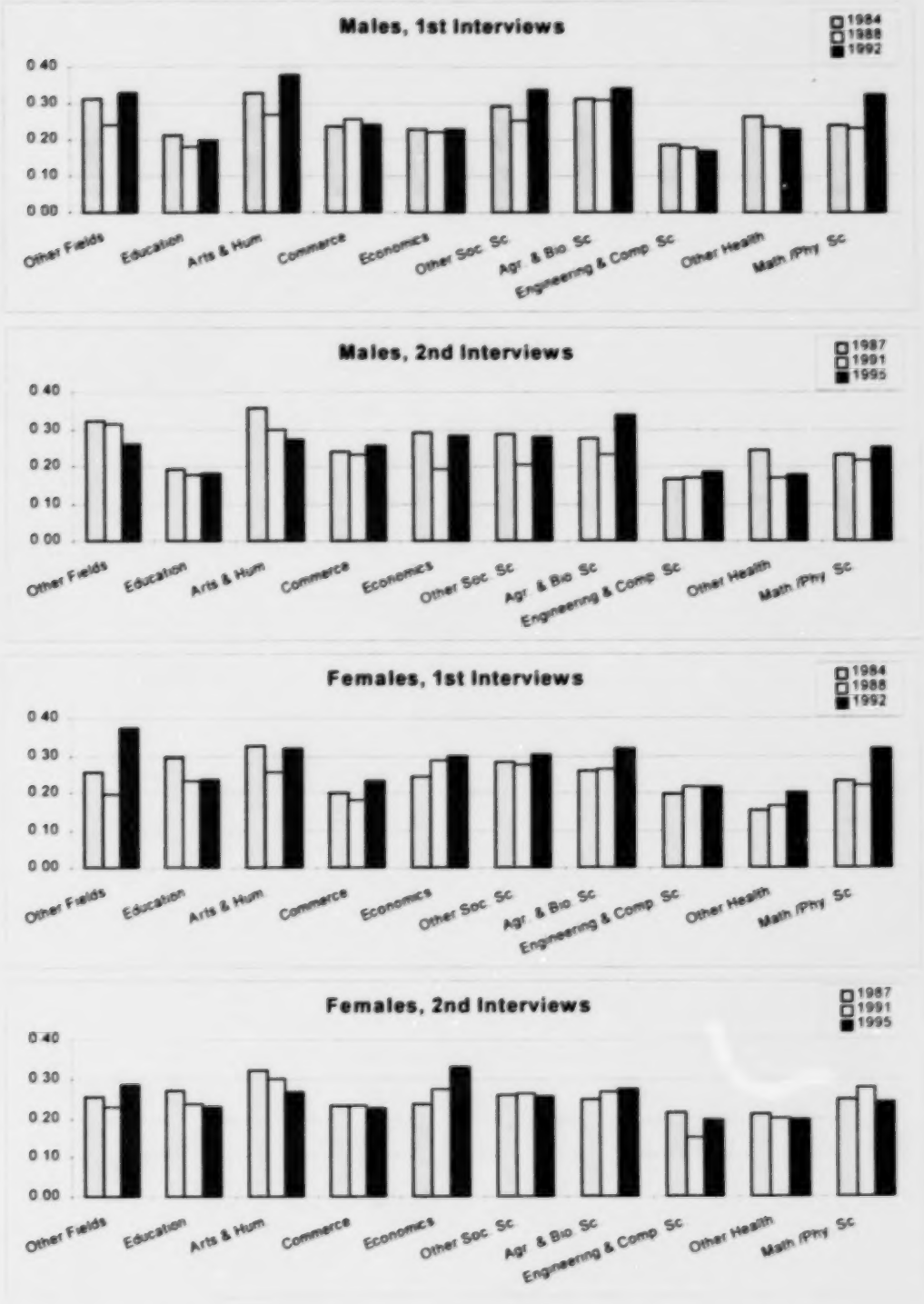
Table 5: Mean Absolute Errors by Field of Study—Model 2

	1982 Cohort		1986 Cohort		1990 Cohort	
	1984	1987	1988	1991	1992	1995
	$	$	$	$	$	$
Males						
All	**0.24**	**0.24**	**0.22**	**0.21**	**0.26**	**0.24**
Other Fields	0.31*	0.32*	0.24	0.31*	0.33*	0.26
Education	0.21	0.19	0.18	0.18	0.20	0.18
Fine Arts & Humanities	0.33	0.36	0.27	0.30	0.38	0.27
Commerce	0.24	0.24	0.25	0.23	0.24	0.25
Economics	0.23	0.29	0.22	0.19	0.23	0.28
Other Social Sciences	0.29	0.29	0.25	0.20	0.34	0.28
Agricultural & Bio. Sc.	0.31	0.27*	0.31	0.23	0.34	0.34
Engineering & Comp. Sc.	0.18	0.17	0.18	0.17	0.17	0.18
Other Health	0.26*	0.24*	0.24*	0.17	0.23*	0.18
Math. & Other Phys. Sc.	0.24	0.23	0.23	0.21	0.32	0.25
Females						
All	**0.26**	**0.26**	**0.23**	**0.24**	**0.27**	**0.24**
Other Fields	0.25*	0.25*	0.19	0.23*	0.37*	0.28
Education	0.29	0.27	0.23	0.23	0.23	0.23
Fine Arts & Humanities	0.32	0.32	0.26	0.30	0.32	0.27
Commerce	0.20	0.23	0.18	0.23	0.23	0.23
Economics	0.24*	0.24	0.28*	0.27	0.30*	0.33
Other Social Sciences	0.28	0.26	0.28	0.26	0.30	0.26
Agricultural & Bio. Sc.	0.26	0.24	0.26	0.27	0.32	0.27
Engineering & Comp.Sc.	0.20	0.21	0.22	0.15	0.22	0.20
Other Health	0.15	0.21	0.17	0.20	0.20	0.19
Math. & Other Phys. Sc.	0.23	0.25*	0.22	0.28*	0.32*	0.24

Note: Calculated as the mean absolute difference between actual log earnings and their predicted values (based on the regression estimates) for the individuals of each field.

* The means with an asterisk have standard errors between 0.01 and 0.02.

Figure 4: Mean Absolute Errors by Field of Study - Model 2



4. Conclusion

Summary of the Findings

The goal of this paper was to exploit the strengths of the relatively under-utilised National Graduate Survey databases to contribute to our understanding of differences in earnings by discipline amongst Bachelor's level university graduates in Canada on an empirical level. The principal findings may be summarised as follows:

- There remain significant gender differences in the distribution of graduates by discipline, with perhaps surprisingly little change in the distributions of graduates across disciplines for either sex for the three cohorts which finished their schooling in 1982, 1986, and 1990 covered in this analysis.

- There have been consistent and in many cases large differences in earnings by discipline: the highest earnings fields are Other Health, Engineering and Computer Science, Commerce, and Mathematics/Physics; the low earnings fields are Arts and Humanities, Agricultural/ Biological Sciences, and Other Social Sciences; while Education and Economics have generally been in the middle of the earning distribution.

- Adding two different sets of control variables to the models typically reduces the (net) field effects, even as the same patterns typically persist to greater or lesser degrees across the various specifications. The effects of discipline on earnings thus appear to operate to some degree through the accumulation of greater labour market experience and other work-related characteristics (including occupation and industry), and are also perhaps associated with certain personal attributes which affect earnings, but "pure" discipline effects remain even after controlling for these influences.

- These patterns are relatively consistent for male and female graduates, at the two and five year interview points, and across the three cohorts of graduates, while the more notable departures from these norms have been noted (with tests indicating that the effects are in fact significantly different along all these dimensions). In particular, there has been no general improvement in the earnings of science and technology graduates (Other Health workers

excepted)—a perhaps somewhat surprising result in a context where these fields are typically cited as being critical to the "knowledge based economy" and students are often urged to enter these areas for the benefit of their own careers as well as the nation's economy; the general (moderate) *declines* in the relative earnings of pure and applied science graduates over this period are especially noteworthy in this regard.

- Overall, the measure of the difference between individuals' actual earnings levels and the level predicted by the regression models reported here is relatively constant across cohorts, with "average errors" ranging from 21 to 27 percent, thus perhaps indicating that labour market outcomes have not necessarily become more variable or uncertain (in this sense) amongst Bachelor's level university graduates over the period covered by this analysis.

- Engineering and Computer Science and Other Health graduates tend to have earnings levels which are more accurately predicted by the regression models, while the greatest (conditional) variation in earnings is amongst Fine Arts and Humanities graduates.

Implications of the Findings

There are various reasons for earnings to differ by field of study. First, there are the vagaries of the market, whereby extraneous shifts in demand or supply (long- or short-term) affect relative earnings patterns – with such effects expected to be greatest for those just entering the labour market and thus at its margins (*e.g.*, recent graduates). Second, compensating differentials would generate enduring earnings differences by discipline, with the underlying factors including the effort required at school and on the job, the degree of stress or level of responsibility, the uncertainty of outcomes, offsetting perquisites, and so on. Third, longer-term ("equilibrium") earnings differences will tend to arise in the face of any general scarcity of skills – for example, engineers and other more technically oriented workers might tend to be higher paid at least partly because there may be a limited number of individuals with the requisite underlying technical abilities. Fourth, there could exist more artificial supply side constraints, perhaps reflecting the structure and behaviour of the post-secondary system itself (*e.g.*, limited admission to certain programmes), associated professional associations (*e.g.*, the exams required to gain final certification in certain professions), the effects of unionisation, and other institutional influences.

The relative stability of wage patterns by discipline which are reported above suggest that these – and any other – forces have actually been relatively steady over time, at least as they apply to the three cohorts of recent Bachelor's level graduates treated here. For example, for all the talk of the manner in which the economy has generally been shifting towards a science and technology orientation, of how "globalisation" has affected national markets, of the emergence of the "knowledge-based economy", of the "polarisation" of employment opportunities and earnings, and so on, the earnings patterns reported above are remarkably stable – as has the distribution of graduates by discipline, with these two results presumably being related (*i.e.*, students should, *ceteris paribus*, tend to move towards disciplines with increasing earnings). Interestingly, the shifts which *are* observed – the declines in the relative earnings of certain science graduates in particular – would seem to go in the opposite direction of what many might have predicted.

The relative consistency of the earnings patterns from two to five years following graduation is also interesting, as it suggests that the above-mentioned forces are relatively consistent over at least the early years in the labour market. At the same time, the shifts which are observed point to some significant differences in age-earnings profiles by discipline, with this surmisal further supported by the initial finding that the discipline effects are in fact statistically different at the earlier and later points in time following graduation. These differences also have implications for our interpretation of previous studies in which the differences in earnings by discipline are estimated across workers of all ages (and sometimes all levels of study) taken together, as such aggregations would seem to be inappropriate, even if required to generate estimates in the context of standard databases which do not have the numbers of observations required to conduct such an analysis at a more detailed level (such as is possible with the NGS data used here).

The general similarity of the earnings patterns across disciplines by gender is also interesting. In short, what "works" for males also works for females, even though there are some moderate differences in this regard. Meanwhile, very large differences in the distribution of graduates across disciplines by gender remain almost unchanged across these three sets of graduates.

Paths for Future Research

Future research could go in a number of directions, but one of these might be to undertake an analysis similar to the one presented here at a more detailed level for selected disciplines to see if

the relatively aggregate level findings reported here – relative stability of the patterns by cohort, year relative to graduation, gender, *etc.* – hold up. It might also be particularly interesting to use the "average error" measure employed here to see how it behaves at a more detailed level and to see if there appear to be (equilibrium?) tradeoffs across disciplines in terms of the average level and variance of earnings.

Another interesting avenue of research would be to look at earnings at a later point in time following graduation, but this would have to await another longer-term follow-up survey of one of the NGS cohorts already interviewed – something which is not currently planned by Statistics Canada and Human Resources Development Canada.

Third, a major related undertaking would be to attempt to model the choice of discipline, with the role of future earnings treated as a central variable, but this would again probably lay beyond the capacity of the NGS data used here due to their lack of background variables (*e.g.*, high school grades or other measures of ability or aptitude, family background, and so on).

In any event, it is hoped that the analysis reported here has contributed to our understanding of earnings by discipline and would provide a useful point of departure for further studies in this area.

Appendix

Table A1: Detailed Regression Results (Model 2)

	1982 Cohort				1986 Cohort				1990 Cohort			
	1984		1987		1988		1991		1992		1995	
	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err
Males												
Intercept	9.56 **	0.68	9.31 **	0.28	9.62 **	0.61	10.25 **	0.78	8.68 **	0.32	10.25 **	0.13
BAplus	-0.19 **	0.07	0.04	0.07	-0.04	0.07	0.03	0.07	0.01	0.09	0.10	0.08
Age	0.02	0.05	0.05 **	0.02	0.02	0.02	0.01	0.01	0.08 **	0.02	0.01	0.01
Age Squared	0.00	0.00	0.00 **	0.00	0.00	0.00	0.00	0.00	0.00 **	0.00	0.00	0.00
Ex1pt	0.03	0.03	-0.02	0.03	0.15	0.14	0.08	0.15	0.05	0.05	-0.05	0.04
Ex1ft	0.17 **	0.02	0.13 **	0.02	0.26	0.14	0.22	0.15	0.13 **	0.03	0.07 **	0.02
Ex2pt	0.08 *	0.03	-0.05	0.04	-0.12	0.48	-0.22	0.55	0.19 **	0.06	0.05	0.05
Ex2ft	0.16 **	0.02	0.11 **	0.03	0.07	0.48	-0.13	0.55	0.20 **	0.04	0.03	0.03
Ex3pt	-0.46 **	0.03	0.09	0.05	-0.47 **	0.05	0.00	0.51	-0.70 **	0.06	-0.06	0.05
Ex3ft			0.13 **	0.03			0.08	0.51			0.08 **	0.03
Ex4pt			-0.41 **	0.04			-0.71 **	0.05			-0.78 **	0.05
Self	0.10 **	0.03	0.16 **	0.03	0.20 **	0.03	0.09 **	0.03	0.08 *	0.04	0.11 **	0.03
Sglpar	0.14	0.20	-0.14	0.12	0.07	0.08	0.36 **	0.09	0.07	0.12	-0.22	0.11
Marnc	0.06 **	0.02	0.04 *	0.02	0.04 *	0.02	0.05 **	0.02	0.03	0.02	0.02	0.02
Marpar	0.12 **	0.03	0.10 **	0.02	0.06 **	0.02	0.11 **	0.02	0.11 **	0.03	0.09 **	0.02
Wsdnc	-0.02	0.08	-0.27 **	0.07	0.10	0.08	0.00	0.06	-0.02	0.10	0.20 **	0.08
Wsdpar	-0.27	0.30	-0.01	0.09	0.26 *	0.13	0.04	0.08	0.07	0.12	0.00	0.09
Atlan	-0.08 **	0.03	-0.12 **	0.03	-0.09 **	0.03	-0.21 **	0.03	-0.22 **	0.03	-0.18 **	0.03
Que	-0.03	0.02	-0.06 **	0.02	-0.07 **	0.02	-0.13 **	0.02	-0.07 **	0.02	-0.11 **	0.02
Prairi	-0.03	0.03	-0.08 **	0.03	-0.14 **	0.03	-0.20 **	0.03	-0.16 **	0.03	-0.15 **	0.03
Albt	0.09 **	0.02	0.02	0.03	-0.06 *	0.03	-0.06 *	0.03	-0.11 **	0.03	-0.03	0.03
Bct	-0.02	0.03	0.00	0.03	-0.04	0.03	-0.03	0.03	-0.02	0.03	0.02	0.03
Engpq1	0.08	0.04	0.00	0.04	-0.03	0.04	0.07	0.04	-0.07	0.05	-0.06	0.05
Frenout1	0.12 **	0.04	0.06	0.05	0.05	0.04	0.05	0.04	0.04	0.04	-0.09 *	0.04
Othall1	0.01	0.02	0.04	0.03	-0.06 *	0.02	-0.09 **	0.02	-0.03	0.03	-0.05 *	0.02
Females												
Intercept	7.76 **	0.66	9.01 **	0.25	8.96 **	0.28	9.20 **	0.78	8.70 **	0.16	9.88 **	0.10
BAplus	0.14	0.12	0.14	0.08	0.02	0.08	0.12	0.07	-0.04	0.08	0.02	0.07
Age	0.14 **	0.05	0.06 **	0.01	0.08 **	0.01	0.07 **	0.01	0.07 **	0.01	0.02 **	0.00
Age Squared	0.00 *	0.00	0.00 **	0.00	0.00 **	0.00	0.00 **	0.00	0.00 **	0.00	0.00 **	0.00
Ex1pt	0.07 *	0.03	-0.01	0.03	-0.14	0.16	-0.20	0.15	0.13 **	0.04	-0.02	0.03
Ex1ft	0.12 **	0.02	0.04	0.02	-0.04	0.16	-0.14	0.15	0.18 **	0.03	0.07 **	0.02
Ex2pt	0.04	0.03	0.06 *	0.04	-0.02	0.16	0.13	0.55	0.21 **	0.06	-0.01	0.04
Ex2ft	0.20 **	0.03	0.04	0.03	0.09	0.16	0.15	0.55	0.27 **	0.04	0.08 *	0.03
Ex3pt	-0.48 **	0.03	0.11 **	0.04	-0.39 **	0.03	-0.07	0.51	-0.54 **	0.05	0.09 *	0.04
Ex3ft			0.25 **	0.03			-0.03	0.51			0.11 **	0.03
Ex4pt			-0.53 **	0.03			-0.68 **	0.05			-0.62 **	0.02
Self	-0.11 *	0.05	-0.15 **	0.05	0.05	0.05	-0.05	0.03	0.01	0.05	-0.17 **	0.03
Sglpar	-0.34 **	0.11	-0.09	0.09	-0.13	0.07	-0.26 **	0.09	0.10	0.08	0.07	0.07
Marnc	0.00	0.02	0.02	0.02	0.04 **	0.02	0.03	0.02	0.07 **	0.02	0.07 **	0.02
Marpar	-0.11 **	0.04	-0.03	0.02	0.06 *	0.03	0.01	0.02	0.02	0.03	0.03	0.02
Wsdnc	-0.02	0.06	0.08	0.06	0.05	0.05	0.08	0.06	-0.06	0.07	-0.02	0.05
Wsdpar	-0.05	0.11	-0.02	0.06	-0.01	0.05	0.10	0.08	-0.09	0.07	0.02	0.05
Atlan	-0.06 *	0.03	-0.12 **	0.03	-0.11 **	0.03	-0.22 **	0.03	-0.19 **	0.03	-0.19 **	0.03
Que	-0.01	0.02	-0.03	0.02	-0.07 **	0.02	-0.03	0.02	-0.06 **	0.02	-0.08 **	0.02
Prairi	0.05	0.03	0.00	0.03	-0.10 **	0.03	-0.15 **	0.03	-0.23 **	0.03	-0.17 **	0.03
Albt	0.11 **	0.03	0.00	0.03	-0.03	0.03	-0.11 **	0.03	-0.16 **	0.03	-0.09 **	0.03
Bct	0.01	0.03	-0.10 **	0.03	-0.07 *	0.03	-0.09 **	0.03	-0.02	0.03	0.07 **	0.03
Engpq1	0.01	0.04	-0.01	0.05	-0.03	0.04	-0.10 *	0.04	-0.07	0.05	-0.09	0.05
Frenout1	0.08 *	0.04	0.12 *	0.05	0.00	0.03	0.11 **	0.04	0.04	0.04	0.10 **	0.03
Othall1	-0.05	0.03	-0.01	0.03	-0.07 **	0.02	0.03	0.02	0.01	0.03	-0.02	0.03

* One asterisk indicates significance at the .05 confidence level.
** Two asterisks indicate significance at the .01 level.

Table A2: Model 3 - Adding Occupation and Industry

	1982 Cohort				1986 Cohort				1990 Cohort			
	1984		1987		1988		1991		1992		1995	
	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err
Males												
Other Fields	-0.06	0.04	-0.04	0.06	-0.04	0.03	0.01	0.03	-0.07	0.04	-0.10 *	0.04
Education	-0.01	0.03	-0.09 **	0.03	-0.01	0.03	-0.02	0.03	0.03	0.03	-0.02	0.03
Arts & Hum.	-0.16 **	0.02	-0.12 **	0.03	-0.09 **	0.02	-0.07 **	0.02	-0.26 **	0.02	-0.11 **	0.02
Commerce	0.01	0.02	0.02	0.02	0.07 **	0.02	0.03	0.02	-0.02	0.02	0.03	0.02
Economics	-0.01	0.03	0.02	0.03	-0.06 *	0.03	-0.05	0.03	0.01	0.03	0.04	0.03
Other Soc. Sc.	-0.02	0.02	-0.03	0.02	-0.02	0.02	-0.07 **	0.02	-0.07 **	0.02	-0.10 **	0.02
Agr. & Bio. Sc.	-0.09 **	0.03	-0.08 *	0.03	-0.13 **	0.03	-0.09 **	0.03	-0.11 **	0.03	-0.14 **	0.03
Eng. & Comp. Sc.	0.07 **	0.02	0.05 *	0.02	0.04	0.02	0.04	0.02	0.08 **	0.02	0.10 **	0.02
Other Health	0.23 **	0.08	0.22 **	0.08	0.21 **	0.05	0.18 **	0.05	0.44 **	0.06	0.27 **	0.06
Math./Phy. Sc.	0.05	0.03	0.05	0.03	0.02	0.03	0.05 *	0.03	-0.01	0.03	0.04	0.03
R^2	0.42		0.36		0.34		0.36		0.46		0.38	
Observations	2370		1904		2143		2005		2235		2193	
Females												
Other Fields	-0.07	0.05	0.03	0.06	0.04	0.04	0.06	0.05	-0.09 *	0.04	0.00	0.04
Education	-0.07 **	0.02	-0.09 **	0.03	0.03	0.02	0.03	0.02	0.00	0.03	-0.03	0.02
Arts & Hum.	-0.15 **	0.02	-0.16 **	0.02	-0.13 **	0.02	-0.08 **	0.02	-0.04	0.03	-0.06 **	0.02
Commerce	0.02	0.02	0.06 *	0.03	0.03	0.02	0.08 **	0.02	0.06 *	0.03	0.03	0.02
Economics	0.01	0.05	-0.10	0.06	0.05	0.04	-0.13 **	0.04	-0.05	0.05	-0.05	0.05
Other Soc. Sc.	-0.09 **	0.02	-0.03	0.02	-0.08 **	0.02	0.00	0.02	-0.03	0.02	-0.04 *	0.02
Agr. & Bio. Sc.	0.00	0.03	-0.05	0.04	-0.09 **	0.03	-0.08 *	0.04	-0.09 **	0.03	-0.07 *	0.03
Eng. & Comp. Sc.	0.11 *	0.04	0.07	0.05	0.00	0.03	0.08 *	0.03	0.07	0.05	0.08 *	0.04
Other Health	0.14 **	0.04	0.15 **	0.04	0.12 **	0.03	0.08 **	0.03	0.20 **	0.04	0.09 **	0.03
Math./Phy. Sc.	0.11 **	0.04	0.12 *	0.05	0.03	0.04	0.00	0.05	-0.02	0.05	0.05	0.04
R^2	0.47		0.42		0.39		0.44		0.39		0.44	
Observations	2253		1884		2432		2182		2567		2545	

Note: The models include a series of 15 dummy variables representing the individual's occupation and 13 dummy variables representing the individual's industry. See table A3 for the detailed regression results.

* One asterisk indicates significance at the .05 confidence level.

** Two asterisks indicate significance at the .01 level.

Table A3: Detailed Regression Results (Model 3)

	1982 Cohort				1986 Cohort				1990 Cohort			
	1984		1987		1988		1991		1992		1995	
	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err
Males												
Intercept	9.88	0.65	9.29	0.27	9.59	0.58	10.23	0.75	8.83	0.30	10.32	0.13
BAplus	-0.19	0.07	0.07	0.07	0.01	0.06	0.11	0.07	0.02	0.08	0.10	0.07
Age	0.00	0.05	0.06	0.02	0.02	0.02	0.01	0.01	0.08	0.02	0.00	0.01
Age Squared	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ex1pt	0.04	0.03	-0.03	0.03	0.21	0.13	0.04	0.14	0.02	0.04	-0.05	0.03
Ex1ft	0.17	0.02	0.12	0.02	0.30	0.13	0.16	0.14	0.09	0.03	0.08	0.02
Ex2pt	0.07	0.03	-0.03	0.04	-0.04	0.45	-0.11	0.53	0.15	0.06	0.04	0.04
Ex2ft	0.13	0.02	0.10	0.03	0.13	0.45	-0.05	0.53	0.20	0.03	0.00	0.03
Ex3pt	-0.41	0.03	0.07	0.05	-0.47	0.05	-0.12	0.49	-0.56	0.06	-0.04	0.05
Ex3ft			0.12	0.03			-0.02	0.49			0.09	0.03
Ex4pt			-0.39	0.04			-0.62	0.05			-0.74	0.04
Self	0.12	0.03	0.14	0.03	0.19	0.03	0.07	0.03	0.09	0.04	0.11	0.03
Prim84	0.09	0.04	0.01	0.04	-0.01	0.05	0.01	0.05	0.01	0.05	0.09	0.05
Manufh84	0.05	0.03	0.05	0.04	0.02	0.03	0.08	0.03	-0.02	0.04	0.02	0.04
Manufm84	-0.05	0.04	-0.06	0.04	-0.03	0.04	0.06	0.04	-0.06	0.05	-0.06	0.05
Manufl84	-0.10	0.05	-0.05	0.06	-0.22	0.05	-0.07	0.05	-0.12	0.05	-0.18	0.05
Contcu84	0.04	0.03	-0.01	0.03	0.02	0.03	0.06	0.03	0.01	0.04	-0.03	0.03
Whole84	0.01	0.04	-0.01	0.04	0.00	0.04	0.10	0.04	-0.11	0.05	-0.08	0.04
Retail84	-0.14	0.04	-0.12	0.04	-0.10	0.04	-0.06	0.04	-0.25	0.04	-0.26	0.04
Fire84	-0.01	0.03	-0.01	0.04	-0.04	0.03	0.02	0.03	-0.09	0.04	-0.08	0.03
Bserv84	-0.10	0.03	-0.04	0.03	-0.12	0.03	0.02	0.03	-0.13	0.03	-0.05	0.03
Eserv84	-0.11	0.04	-0.16	0.05	-0.10	0.04	-0.03	0.04	-0.15	0.05	-0.16	0.05
Hserv84	-0.18	0.04	-0.13	0.05	-0.25	0.04	-0.06	0.04	-0.21	0.04	-0.12	0.04
Pserv84	-0.32	0.03	-0.26	0.04	-0.28	0.04	-0.21	0.04	-0.33	0.04	-0.28	0.04
Manage84	0.13	0.04	0.11	0.04	0.11	0.04	0.17	0.04	0.02	0.04	0.15	0.04
Manrel84	0.03	0.04	-0.01	0.05	-0.02	0.04	0.14	0.05	0.03	0.05	0.11	0.04
Phybio84	0.06	0.05	-0.06	0.06	0.06	0.06	0.04	0.06	-0.04	0.07	-0.01	0.06
Arceng84	0.11	0.04	0.02	0.05	0.11	0.05	0.14	0.05	0.00	0.05	0.06	0.05
Matsys84	0.11	0.04	0.05	0.05	0.10	0.05	0.12	0.05	0.11	0.05	0.14	0.05
Prof84	-0.09	0.08	-0.11	0.10	-0.34	0.07	-0.23	0.08	-0.48	0.08	-0.14	0.10
Teach84	0.16	0.05	0.14	0.06	0.13	0.05	0.11	0.06	0.03	0.06	0.20	0.05
Diag84	0.01	0.09	0.00	0.15	0.27	0.09	0.50	0.09	0.16	0.11	0.52	0.11
Health84	0.10	0.07	-0.05	0.08	0.17	0.06	0.12	0.07	-0.12	0.08	0.08	0.08
Artrec84	0.10	0.05	-0.01	0.05	0.16	0.05	0.06	0.06	-0.13	0.06	0.07	0.06
Clerk84	-0.11	0.04	-0.14	0.05	-0.11	0.05	-0.08	0.05	-0.18	0.05	-0.17	0.05
Sales84	0.06	0.04	0.14	0.05	0.13	0.05	0.06	0.05	0.07	0.05	0.16	0.05
Serve84	-0.03	0.04	-0.19	0.06	0.10	0.05	0.15	0.06	-0.31	0.05	0.06	0.05
Prod84	-0.05	0.04	-0.02	0.05	-0.03	0.05	-0.01	0.05	-0.21	0.05	-0.13	0.05
Sglpar	0.09	0.19	-0.14	0.12	0.01	0.08	0.30	0.09	-0.01	0.11	-0.16	0.11
Marnc	0.06	0.02	0.04	0.02	0.03	0.02	0.04	0.02	0.01	0.02	0.02	0.02
Marpar	0.11	0.03	0.08	0.02	0.06	0.02	0.10	0.02	0.08	0.03	0.08	0.02
Wsdnc	0.00	0.08	-0.25	0.07	0.08	0.07	0.04	0.06	-0.01	0.09	0.14	0.07
Wsdpar	-0.11	0.29	-0.05	0.09	0.22	0.12	0.00	0.08	0.02	0.11	-0.03	0.08
Atlan	-0.08	0.03	-0.11	0.03	-0.09	0.03	-0.20	0.03	-0.19	0.03	-0.17	0.03
Que	-0.03	0.02	-0.05	0.02	-0.07	0.02	-0.12	0.02	-0.08	0.02	-0.10	0.02
Prain	-0.05	0.03	-0.06	0.03	-0.13	0.03	-0.19	0.03	-0.15	0.03	-0.13	0.03
Albt	0.07	0.02	0.04	0.03	-0.06	0.03	-0.04	0.03	-0.12	0.03	-0.03	0.03
Bct	-0.02	0.03	0.01	0.03	-0.03	0.03	-0.02	0.03	-0.01	0.03	0.04	0.03
Engpq1	0.06	0.04	0.00	0.04	-0.03	0.04	0.03	0.04	-0.06	0.05	-0.05	0.05
Frencut1	0.12	0.04	0.07	0.04	0.02	0.04	0.04	0.04	-0.01	0.04	-0.10	0.04
Othall1	0.02	0.02	0.05	0.03	-0.03	0.02	-0.08	0.02	-0.02	0.03	-0.04	0.02

Cont.

Table A3: (*Cont.*)

	1982 Cohort				1986 Cohort				1990 Cohort			
	1984		1987		1988		1991		1992		1995	
	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err.	Coeff.	Std Err
Females												
Intercept	8.16	0.62	9.31	0.24	9.13	0.27	9.32	0.42	9.05	0.16	10.10	0.10
BAplus	0.09	0.11	0.10	0.07	0.03	0.08	0.12	0.08	-0.04	0.08	0.03	0.07
Age	0.12	0.04	0.05	0.01	0.07	0.01	0.07	0.02	0.06	0.01	0.02	0.00
Age Squared	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ex1pt	0.04	0.03	-0.01	0.03	-0.21	0.15	-0.17	0.15	0.10	0.04	-0.01	0.03
Ex1ft	0.10	0.02	0.03	0.02	-0.13	0.15	-0.10	0.15	0.18	0.03	0.07	0.02
Ex2pt	0.01	0.03	0.07	0.04	0.08	0.15	0.13	0.23	0.19	0.05	-0.03	0.04
Ex2ft	0.17	0.02	0.04	0.03	0.18	0.15	0.12	0.22	0.25	0.04	0.05	0.03
Ex3pt	-0.44	0.03	0.11	0.04	-0.39	0.03	-0.13	0.27	-0.51	0.05	0.10	0.04
Ex3ft			0.21	0.03			-0.09	0.26			0.11	0.03
Ex4pt			-0.54	0.03			-0.65	0.02			-0.61	0.02
Self	-0.06	0.05	-0.12	0.05	0.09	0.05	-0.03	0.04	0.01	0.05	-0.14	0.03
Prim84	-0.05	0.06	-0.16	0.08	0.02	0.07	0.07	0.07	-0.07	0.08	0.02	0.07
Manufh84	0.09	0.06	0.11	0.06	0.04	0.04	0.09	0.05	0.03	0.06	0.18	0.05
Manufm84	0.03	0.07	-0.07	0.07	-0.02	0.06	0.12	0.07	-0.01	0.08	-0.12	0.06
Manufl84	-0.01	0.05	-0.15	0.07	-0.24	0.05	-0.11	0.06	-0.21	0.07	-0.22	0.06
Contcu84	0.04	0.04	0.06	0.05	0.06	0.04	0.10	0.04	0.07	0.05	-0.01	0.04
Whole84	-0.05	0.06	-0.12	0.06	-0.04	0.05	-0.03	0.05	-0.09	0.06	-0.05	0.06
Retail84	-0.26	0.04	-0.23	0.05	-0.23	0.04	-0.19	0.04	-0.21	0.04	-0.24	0.04
Fire84	-0.11	0.04	-0.08	0.05	-0.07	0.03	-0.01	0.04	-0.05	0.04	-0.08	0.03
Bserv84	-0.14	0.03	-0.10	0.04	-0.12	0.03	-0.05	0.04	-0.15	0.04	-0.14	0.03
Eserv84	0.07	0.04	-0.01	0.04	-0.05	0.04	-0.01	0.04	-0.15	0.04	-0.03	0.04
Hserv84	-0.12	0.03	-0.20	0.04	-0.06	0.03	-0.08	0.03	-0.15	0.04	-0.13	0.03
Pserv84	-0.32	0.04	-0.28	0.04	-0.29	0.03	-0.20	0.04	-0.24	0.04	-0.29	0.04
Manage84	0.06	0.04	0.03	0.04	0.09	0.03	0.12	0.04	-0.02	0.04	0.01	0.03
Manrel84	0.05	0.04	-0.10	0.04	0.01	0.03	0.05	0.04	-0.01	0.04	0.00	0.04
Phybio84	0.03	0.06	-0.07	0.07	-0.11	0.07	0.02	0.08	-0.07	0.07	-0.12	0.07
Arceng84	0.09	0.07	-0.02	0.08	0.12	0.06	0.03	0.06	0.00	0.07	-0.08	0.06
Matsys84	0.15	0.05	0.05	0.06	0.15	0.05	0.12	0.05	0.11	0.06	0.11	0.05
Prof84	-0.41	0.07	-0.35	0.08	-0.32	0.07	-0.29	0.09	-0.25	0.08	-0.23	0.08
Teach84	0.00	0.04	-0.06	0.04	-0.01	0.04	-0.05	0.04	0.09	0.04	-0.06	0.04
Diag84	0.08	0.09	-0.12	0.15	0.09	0.09	0.23	0.11	0.33	0.12	0.18	0.10
Health84	0.11	0.05	-0.02	0.05	0.05	0.04	0.13	0.04	0.07	0.05	0.12	0.04
Artrec84	0.00	0.05	0.05	0.06	0.07	0.05	-0.08	0.06	-0.17	0.05	0.00	0.05
Clerk84	-0.11	0.03	-0.30	0.04	-0.12	0.03	-0.19	0.04	-0.25	0.04	-0.28	0.04
Sales84	0.04	0.05	-0.07	0.06	0.01	0.04	-0.01	0.05	-0.16	0.05	-0.12	0.04
Serve84	-0.13	0.05	-0.21	0.07	-0.24	0.05	-0.11	0.06	-0.21	0.05	-0.24	0.05
Prod84	-0.14	0.06	-0.24	0.08	-0.21	0.07	-0.29	0.07	-0.16	0.07	-0.22	0.06
Sglpar	-0.38	0.11	-0.13	0.09	-0.17	0.06	-0.24	0.10	0.10	0.08	0.10	0.06
Marnc	-0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.05	0.02	0.04	0.02
Marpar	-0.11	0.04	-0.04	0.02	0.04	0.02	0.01	0.02	0.00	0.03	0.01	0.02
Wsdnc	-0.04	0.06	0.06	0.06	0.04	0.05	0.11	0.05	-0.01	0.06	-0.03	0.05
Wsdpar	-0.04	0.10	0.00	0.06	0.02	0.05	0.08	0.06	-0.10	0.06	0.00	0.05
Atlan	-0.06	0.03	-0.10	0.03	-0.11	0.03	-0.21	0.03	-0.17	0.03	-0.17	0.02
Que	-0.02	0.02	-0.02	0.02	-0.07	0.02	-0.03	0.02	-0.05	0.02	-0.08	0.02
Prair	0.03	0.03	-0.01	0.03	-0.10	0.03	-0.15	0.03	-0.21	0.03	-0.16	0.03
Albt	0.07	0.03	-0.01	0.03	-0.04	0.03	-0.12	0.03	-0.14	0.03	-0.09	0.02
Bct	0.01	0.03	-0.09	0.03	-0.07	0.03	-0.11	0.03	0.00	0.03	0.08	0.02
Engpq1	0.04	0.04	-0.01	0.05	0.00	0.04	-0.12	0.05	-0.04	0.05	-0.07	0.05
Frencut1	0.07	0.04	0.09	0.04	-0.01	0.03	0.12	0.03	0.02	0.04	0.08	0.03
Othall1	-0.02	0.03	0.02	0.03	-0.08	0.02	0.02	0.02	0.01	0.03	-0.04	0.02

* One asterisk indicates significance at the .05 confidence level.
** Two asterisks indicates significance at the .01 level.

Table A4: Mean Absolute Errors by Field of Study (Model 3)

	1982 Cohort		1986 Cohort		1990 Cohort	
	1984	1987	1988	1991	1992	1995
	$	$	$	$	$	$
Males						
All	**0.22**	**0.22**	**0.20**	**0.20**	**0.24**	**0.23**
Other Fields	0.26	0.31	0.20	0.29	0.29	0.22
Education	0.20	0.18	0.18	0.17	0.19	0.17
Fine Arts & Humanities	0.29	0.33	0.25	0.27	0.32	0.25
Commerce	0.22	0.22	0.22	0.22	0.23	0.25
Economics	0.22	0.27	0.22	0.20	0.21	0.26
Other Social Sciences	0.27	0.28	0.24	0.18	0.30	0.26
Agricultural & Bio. Sc.	0.30	0.29	0.29	0.22	0.31	0.31
Engineering & Comp. Sc.	0.17	0.16	0.17	0.17	0.16	0.18
Other Health	0.26	0.25	0.21	0.19	0.23	0.19
Math. & Other Phys. Sc.	0.21	0.22	0.21	0.20	0.30	0.23
Females						
All	**0.23**	**0.24**	**0.21**	**0.23**	**0.25**	**0.22**
Other Fields	0.27	0.21	0.19	0.24	0.29	0.27
Education	0.25	0.24	0.22	0.23	0.22	0.21
Fine Arts & Humanities	0.29	0.29	0.24	0.27	0.31	0.24
Commerce	0.18	0.22	0.16	0.20	0.22	0.21
Economics	0.21	0.22	0.29	0.27	0.27	0.29
Other Social Sciences	0.26	0.23	0.24	0.24	0.29	0.23
Agricultural & Bio. Sc.	0.24	0.24	0.25	0.22	0.29	0.25
Engineering & Comp.Sc.	0.19	0.20	0.18	0.16	0.20	0.18
Other Health	0.15	0.22	0.17	0.20	0.19	0.21
Math. & Other Phys. Sc.	0.18	0.22	0.19	0.24	0.28	0.22

Note: Calculated as the mean absolute difference between actual log earnings and their predicted values (based on the regression estimates) for the individuals of each field.

Figure A1: Model 3 Coefficient Estimates

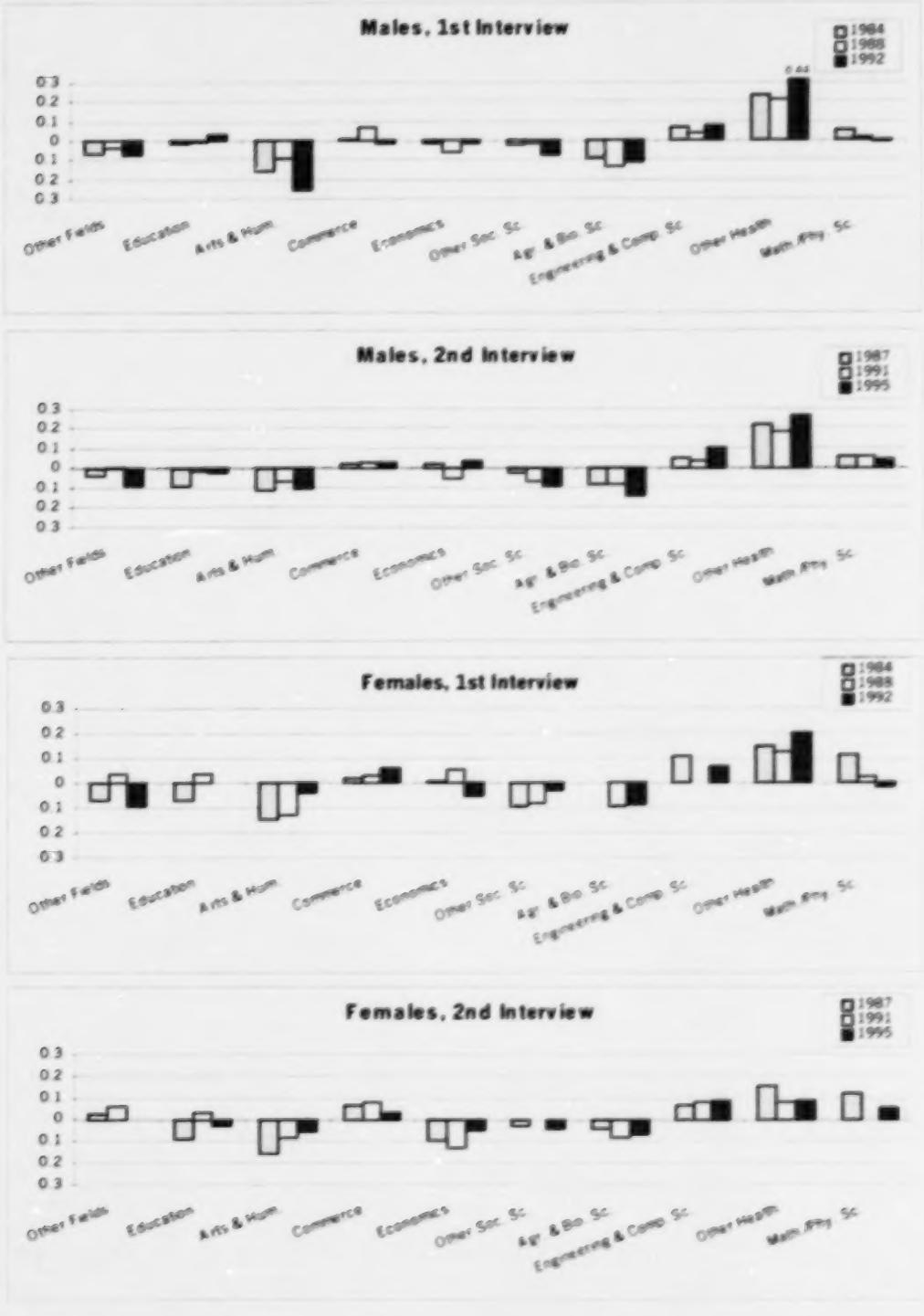


Figure A2: Regression Results by Model

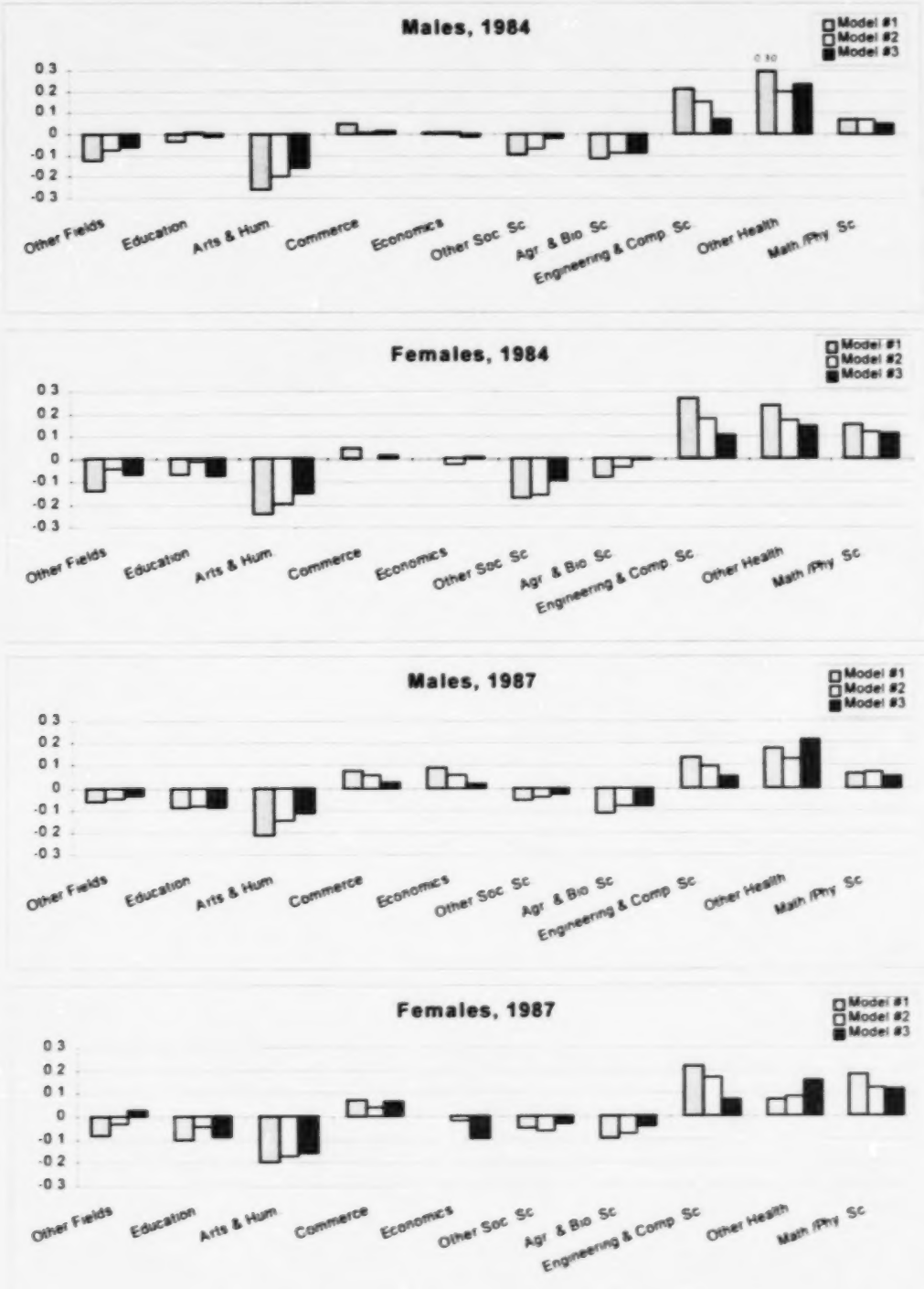


Figure A2: (*cont.*)

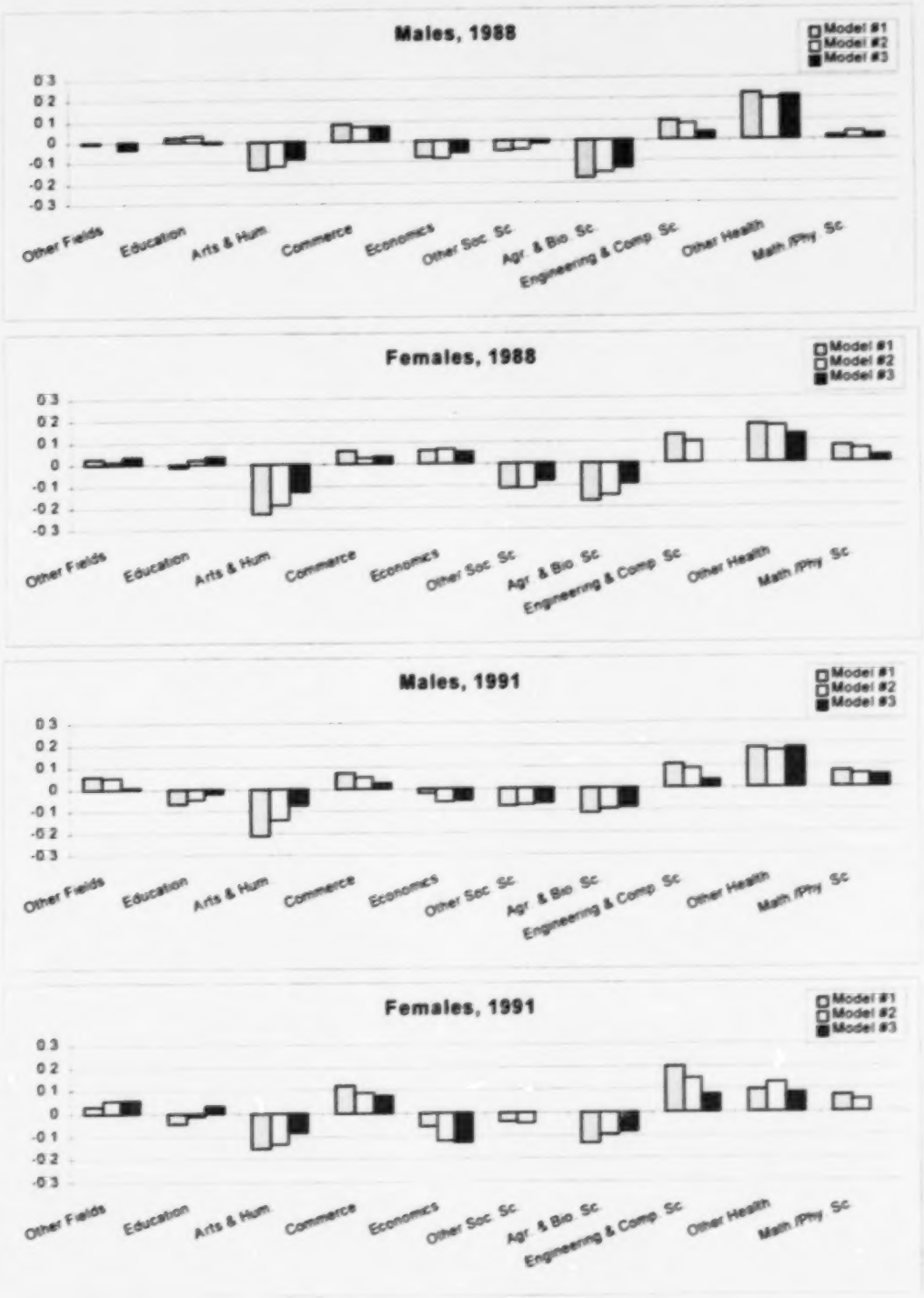


Figure A2: (*cont.*)

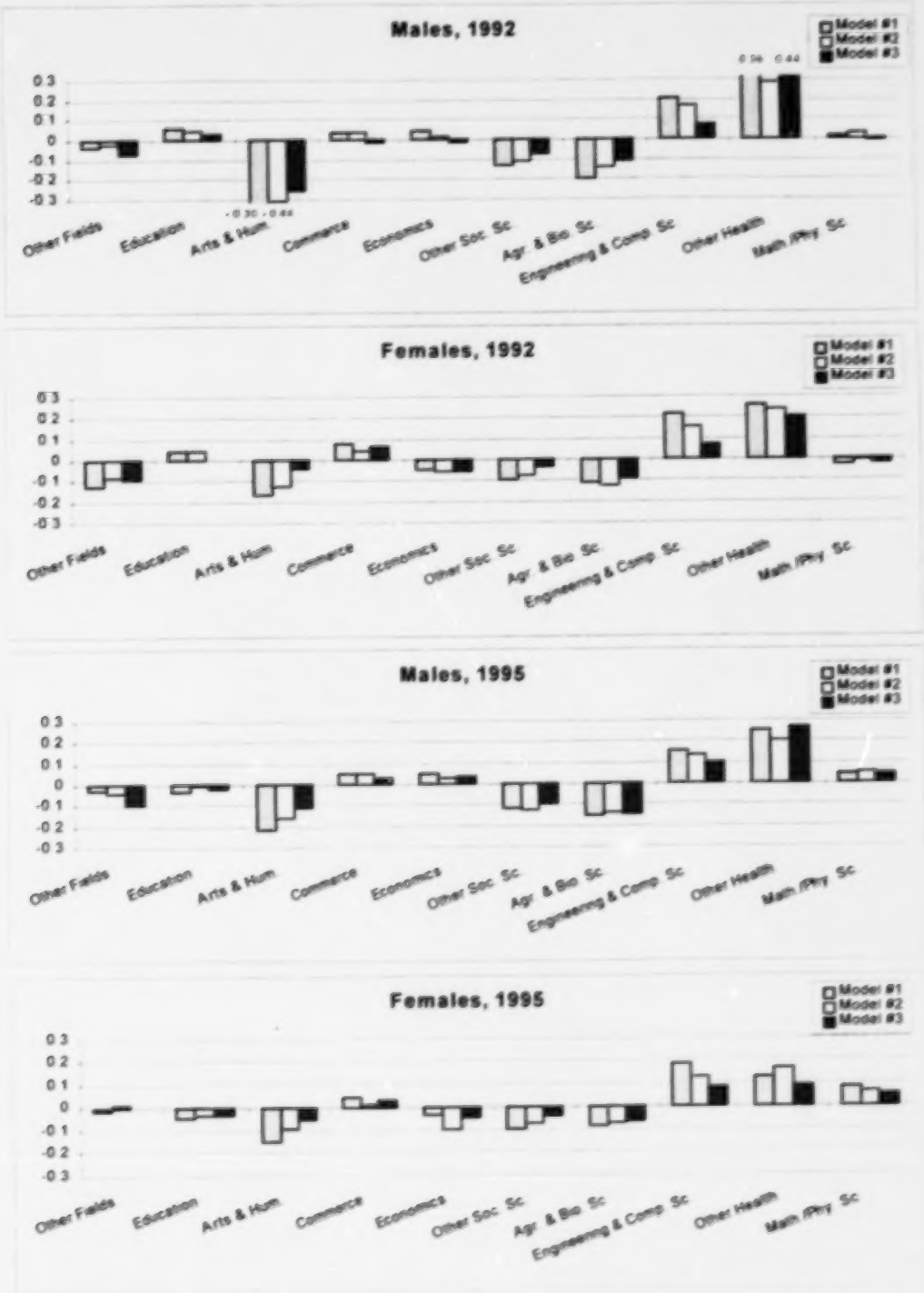
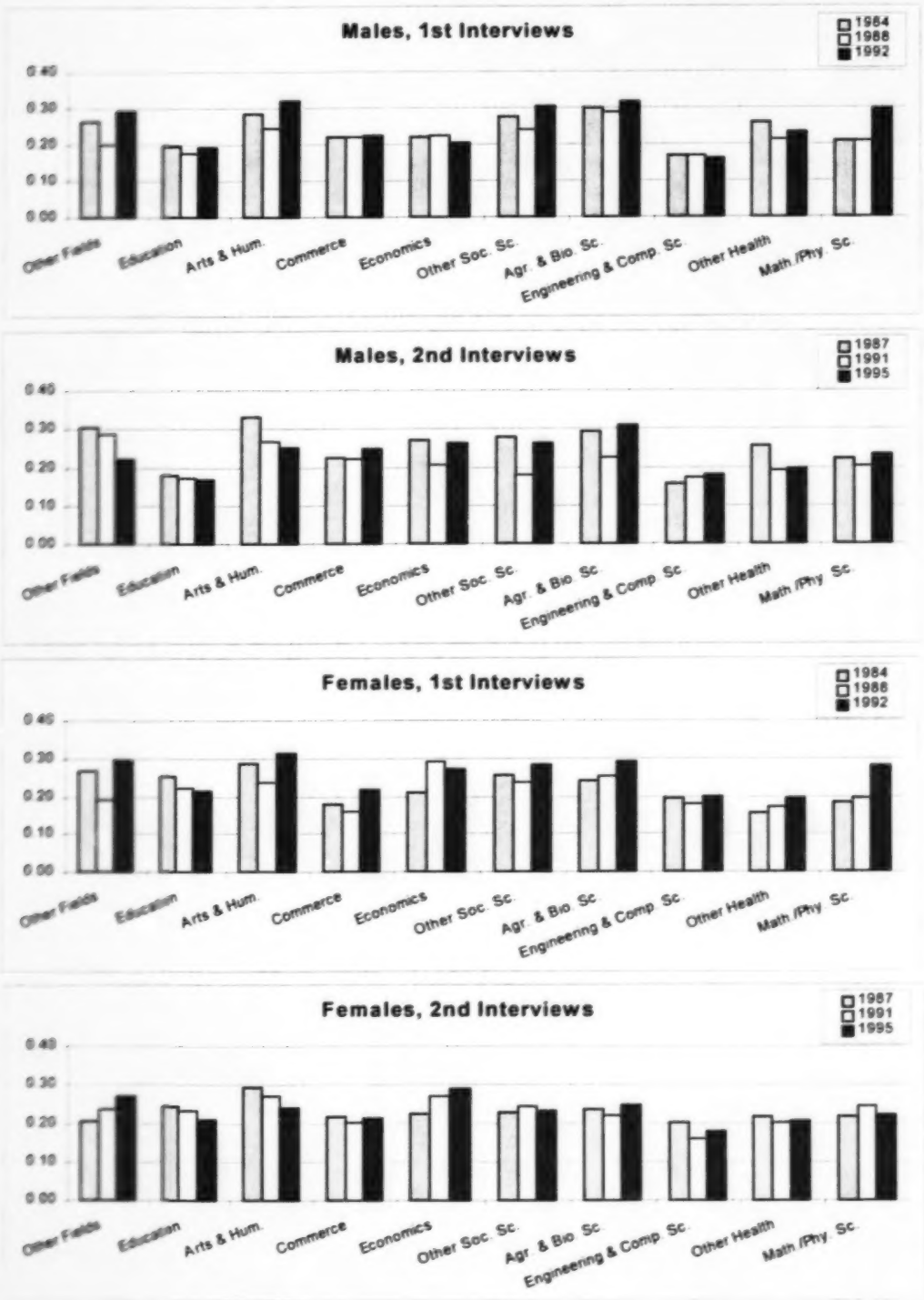


Figure A3: Mean Absolute Errors by Field of Study (Model 3)



References

Abbott, Michael, Ross Finnie and Ted Wannell [Forthcoming], "Gender Differences in the Earnings Growth of Recent University Graduates in Canada: Empirical Evidence from the National Graduate Surveys," Human Resources Development Canada and Statistics Canada.

Beaudry, Paul, and David Green [1997], "Cohort Patterns in Canadian Earnings: Assessing the Role of Skill Premia in Inequality Trends," mimeo, Department of Economics, University of British Columbia.

Beach, Charles M. and Ross Finnie [1998], "Earnings Mobility 1982-1994," *Canadian Business Economics*, Vol. 6, No. 4 (November 1998), pp. 3-25.

Beach, Charles M., and George A. Slotsve [1996], *Are We Becoming Two Societies?* Toronto: C.D. Howe Institute.

Betts, Julian, Chris Ferrall, and Ross Finnie [1999], "The Effects of School Quality on Bachelor's Graduates' Earnings," forthcoming Statistics Canada (Analytical Studies Branch) Working Paper.

_____ [1998], "Time to First Job – a Hazard Model Approach Using the National Graduates Survey," forthcoming Statistics Canada (Analytical Studies Branch) Working Paper.

Burbidge, John and Ross Finnie [1999], "The Geographical Mobility of Baccalaureate Graduates: Evidence From Three Cohorts of the National Graduates Surveys, 1982, 1986, 1990," Human Resources Development Canada and Statistics Canada.

Coté, Sylvain and Arthur Sweetman [1997], "Does it Matter What I Study? Post-Secondary Field of Study and Labour Market Outcomes in Canada," unpublished mimeo, University of Victoria.

Dodge, David and David A. A. Stager [1972], "Economic returns to Graduate Study in Science, Engineering and Business," *Canadian Journal of Economics*, Vol. V, No. 2, (May), pp. 182-98.

Finnie, Ross [1999a], "A Dynamic Analysis of The School-to-Work Transition of Post Secondary Graduates in Canada in the 1980s," Human Resources Development Canada (Applied Research Branch) Research Paper R-99-14E.

_____ [1999b], "Earnings of Post-Secondary Graduates in Canada: Changes in the Structure of Earnings in the 1980s and 1990s," Human Resources Development Canada (Applied Research Branch) Research Paper R-99-12E.b.

Finnie, Ross [1999c], "Earnings of University Graduates in Canada by Discipline: Fields of Plenty, Fields of Lean–A Cross-Cohort Longitudinal Analysis of Early Labour Market Outcomes," Human Resources Development Canada (Applied Research Branch) Research Paper R-99-13E.a.

_____ [1999d], "Holding Their Own: The Employment Patterns and Earnings of Canadian Post-Secondary Graduates in the 1980s and 1990s," *Canadian Business Economics* (forthcoming); also, Human Resources Development Canada (Applied Research Branch) Research Paper R-99-12E.a titled "Earnings of Post-Secondary Graduates in Canada: Holding Their Own - Trends in Earnings Levels and Employment Rates."

_____ [1997a], "Earnings Dynamics in Canada—The Correlation of Individuals' Earnings Over Time in Canada, 1982-92," Human Resources Development Canada (Applied Research Branch) Working Paper W-97-3E.c.

_____ [1997b], "Earnings Dynamics in Canada—The Distribution of Earnings in a Dynamic Context in Canada, 1982-92," Human Resources Development Canada (Applied Research Branch) Working Paper W-97-3E.b.

_____ [1997c], "Earnings Dynamics in Canada—The Earnings Mobility of Canadians, 1982-1992," Human Resources Development Canada (Applied Research Branch) Working Paper W-97-3E.a.

_____ [1997d], "Stasis and Change: Trends in Individuals' Earnings Inequality, 1982-92," *Canadian Business Economics*, Vol. 5, No. 4 (October-December/Fall), pp. 84-107.

_____ [1995], *Steppin' Out: An Analysis of Recent University Graduates Into the Labour Market*, Industry Canada, Working Paper Number 5 (May), p. 129.

Finnie, Ross, and Gaetéan Garneau [1999], "Student Borrowing in the 1990s," paper prepared for the Centre for Education Statistics at Statistics Canada, 1999.

_____ [1996], "An Analysis of Student Borrowing for Post-Secondary Education," *Canadian Business Economics*, Vol. 4, No. 2 (January-March/Winter), pp. 51-64.

Finnie, Ross, and David Gray [1998], "The Dynamics of the Earnings Distribution in Canada: An Econometric Analysis," Human Resources Development Canada (Applied Research Branch) Working Paper W-98-4E.

Finnie, Ross and Saul Schwartz [1996], *Student Loans in Canada: Past, Present and Future*, Toronto: C.D. Howe Institute, pp. 162.

Finnie, Ross and Ted Wannell [1999], "The Gender Earnings Gap Amongst Canadian Bachelor's Level University Graduates: A Cross-Cohort, Longitudinal Analysis," in Richard

Chaykowski and Lisa Powell (eds.), *Women and Work*, Kingston/Montreal: Queen's/McGill Press, forthcoming.

Krahn, Harvey [1996], "School-Work Transitions: Changing Patterns and Research Needs," discussion paper prepared for Human Resources Development Canada (Applied Research Branch).

Lavoie, Marie and Ross Finnie [1999], "Is it Worth Doing a Science or Technology Degree in Canada? Empirical Evidence and Policy Implications," forthcoming article for *Canadian Public Policy*.

_____ [1998a], "The Early Careers of Engineers and the Accumulation of Skills in the Canadian Economy," *Economics of Innovation and New Technology*, Vol. 7, No. 3, pp. 53-69.

_____ [1998b], "The Management Ladder for Recent Engineering Graduates in Canada," *International Journal of Innovation Management*, Vol. 2, No. 3.

_____ [1998c], "The Occupational Dynamics of Recent Canadian Engineering Graduates Inside and Outside the Bounds of Technology," *Research Policy*, Vol. 27, No. 2, pp. 143-160.

Mehmet, Ozay [1977], Economic Returns on Undergraduate Fields of Study in Canadian Universities: 1961 to 1972," Industrial Relations/Relations Industrielles, Vol. 32, No. 3, pp. 321-339.

Morissette, René, and Charles Bérubé [1996], "Longitudinal Aspects of Earnings Inequality in Canada," Analytical Studies Branch, Statistics Canada, Research Paper No. 94.

Morissette, René, John Myles, and Garnett Picot [1995], "Earnings Polarization in Canada, 1969-1991," in Banting, Keith G., and Charles M. Beach (eds.), *Labour Market Polarization and Social Policy Reform*, Kingston, Ontario: School of Policy Studies, Queen's University, 1995, pp. 1-20.

Murphy, Kevin M. and Finis Welch [1990], "Empirical Age-Earnings Profiles," *Journal of Labour Economics*, Vol. 8 (April), pp. 202-29.

OECD [1996], *Employment Outlook*, Chapter 4: "Growing Into Work: Youth and the Labour Market Over the 1980s and 1990s," pp. 109-159, Paris: Organization for Economic Cooperation and Development.

Picot, Garnett [1997], "What is Happening to Earnings Inequality in the 1990s?" *Canadian Business Economics*, Vol. 5, No. 4 (October-December/Fall), pp. 3-16.

Riddell, Craig, [1995], "Human Capital Formation in Canada: Recent Developments and Policy Responses," in Keith G. Banting and Charles M. Beach (eds.), *Labour Market Polarization and Social Policy Reform*, Kingston, Ontario: School of Policy Studies, Queen's University, 1995, pp. 125-172.

Vaillancourt, François [1995], "The Private and Total Returns to Education in Canada," *Canadian Journal of Economics*, Vol 28, No. 3 (August), pp. 532-553.

Zyblock, Myles [1997], "Individual Earnings Inequality and Polarization: An Exploration into Sub-Population Trends in Canada, 1981 to 1993," *Canadian Business Economics*, Vol. 5, No. 4 (October-December/Fall).